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Recent Developments in the Production and Marketing of

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# Apple Sauce and Slices

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FOREWORD

This bulletin has been prepared as a reference work for Extension and research personnel. It should also be of interest to apple industry leaders at both the grower and processor level.

A companion publication, Recent Developments in the Production and Marketing of Apple Juice and Cider, was issued in July 1964 (39 pp.).

Single copies of each report may be obtained by writing the Division of Marketing and Utilization Sciences, Federal Extension Service, U. S. Department of Agriculture, Washington, D. C.



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## Notes

Footnotes are numbered consecutively within each chapter. Where op. cit. is used, it means that the full reference has been provided under the author's name earlier in the chapter.

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RECENT DEVELOPMENTS IN THE PRODUCTION  
AND MARKETING OF APPLE SAUCE AND SLICES

by  
Dana G. Dalrymple and Irvin C. Feustel\*

I. INTRODUCTION

In recent years there has been a substantial increase in the production and consumption of commercially processed apple sauce and slices (especially sauce) in the United States. This trend is likely to continue. The expansion in commercial processing -- in part representing a substitution for home processing and preparation -- carries with it important implications for the apple industry.<sup>1/</sup>

To be more specific, the growth in commercially processed sauce and slices has led to the need for certain adjustments in the apple industry. While the demand for processed apples has apparently increased, the supply of the varieties of apples which have ordinarily been considered best for commercial processing has not undergone a corresponding expansion.<sup>2/</sup> This situation is all the more curious because the demand for fresh market apples appears to be decreasing, while the supply of these varieties (e.g., Red Delicious) is undergoing a sharp increase. Thus, the supply and demand situation for apples is increasingly moving out of balance.<sup>3/</sup>

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- <sup>1/</sup>From one point of view the industry has not heretofore been generally oriented to processing: for some time (as, for instance, in two randomly selected years, 1957 and 1962) a smaller portion of the United States apple crop has been commercially processed than has been true of any of the 12 major domestic tree fruits except plums. (Based on data reported in the following U. S. Department of Agriculture annual reports: Fruits, Noncitrus, by States and Citrus Fruits, by States.)
- <sup>2/</sup>An exception to this trend is provided by the heavy plantings of Golden Delicious -- a fresh market variety which is also good for processing.
- <sup>3/</sup>This matter has been discussed in greater detail by Dalrymple in "Economic Aspects of Apple Marketing in the United States," Michigan State University, Dept. of Agricultural Economics, Ph. D. dissertation, 1962, pp. 303-308. A regional approach was taken by Robert L. LaBelle in "Plantings of Apple Varieties in Western New York and Their Eventual Impact on Processing," Cornell University, Dept. of Food Science and
- (cont.)

Why is this happening? Part of the answer may be that in the period when the trees presently coming into production were planted, growers felt that the fresh market was more remunerative than the processed and planted accordingly. But it takes up to a dozen years for trees to come into full bearing and during that time conditions can change. They have. Demand for processed -- not fresh market apples -- has increased in the interval. As larger crops materialize in the future, the price differentials that may have existed between fresh and processed outlets in the past will probably narrow.

There is likely, therefore, to be more interest in selling apples to processors for sauce and slices. But if this happens, both grower and processor may well face frustrations. The growers may find themselves (1) with varieties which are presently not considered well adapted for slices and sauce, and/or (2) in an area not well supplied with processing facilities. Processors may increasingly find themselves unable to obtain sufficient quantities of desired varieties but flooded with less preferred varieties.

What is to be done? From a long-run point of view, one approach would be to initiate an educational program concerning the characteristics and needs of the processing industry. At present there is little general educational material available on apple processing. Greater knowledge would enable both growers and processors to better adjust to the needs of the other. The development of such material might, for instance, encourage increased plantings of varieties considered more suitable for processing.

Unfortunately, there may not be time to wait for a long-run solution. The problem is at hand. A solution is needed now. One answer seems to be to consider ways in which fresh market varieties can be more effectively and more efficiently used for processing. This approach, in turn, involves biological and economic considerations of broad and complex nature. Such an analysis, in fact, leads us back to a comprehensive review of recent developments in the production and marketing of apple sauce and slices.

This report, then, attempts to consider both long-run and short-run needs of the apple processing industry. First, it provides the general information that may enable producer and processor to better understand themselves and each other -- and which will hopefully lead to better long-run adjustment. Such an approach, moreover, provides the background necessary for a more explicit examination of the very real short-run question of how fresh varieties may better be used for processing.

In view of these purposes, the bulletin is not presented as a technical treatise on how to process apples. Detailed discussions of technique may

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Technology (Geneva), February 13, 1963, 5 pp. More recent fruit tree surveys have made possible further delineation of the production aspects. See, for example: [Ben H. Pubols], Projections of Apple Production in the United States, U. S. Senate, Committee on Commerce, August 1964, 7 pp.; Ben H. Pubols, "Apple Trends and Prospects," Fruit Situation, U. S. Department of Agriculture, August 1964, pp. 22-25; Earl L. Park, "Recent Trends in Apple Tree Numbers," Fruit Situation, January 1965, pp. 17-19.



be found elsewhere.<sup>4/</sup> We have assumed, rather, that the reader has some familiarity with apples and the methods employed in the apple processing industry. Our emphasis will be placed on the general economic framework of the industry, and on significant production and marketing innovations. The period covered will be that from 1950 to the present, particularly the more recent ten years.

## II. ECONOMIC STATISTICS

In order to provide an idea of the structure of the apple sauce and slice industry, we shall make use of recent economic statistics. These statistics will be examined at four levels: (A) farm, (B) processor, (C) retail, and (D) consumer.<sup>1/</sup> The data from several of these levels are treated to a more analytical treatment in a final section.

### A. Farm Level

Economic statistics available at the farm level for apple sauce and slices concern (1) utilization, (2) prices, and (3) value. Most of the data have been issued by the U. S. Department of Agriculture (USDA) and are grouped under three categories: canning, freezing, and drying. We shall use the total data for canned, frozen, and dried interchangeably with the total for sauce and slices.

#### 1. Utilization

Over the ten-year period from 1954 to 1963 an average of 26.7 million bushels of apples was used annually for processing into sauce and slices.<sup>2/</sup> This represented about 22.6% of the average annual apple crop for that period.<sup>3/</sup> During the last three seasons of the period the proportion used

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<sup>4/</sup>The state of knowledge as of 1950 is well summarized by R. M. Smock and A. M. Neubert in Apples and Apple Products, Interscience Publishers, New York, 1950, pp. 245-312. Other texts include: A Complete Course in Canning, The Canning Trade, Baltimore, 1958 (8th edition), pp. 185-188; D. K. Tressler and C. F. Evers, The Freezing Preservation of Foods, Avi Publishing Co., Westport, 1957 (3rd edition), Vol. I, pp. 470-473, 517-523; W. B. Van Arsdel and M. J. Copley, Food Dehydration; Products and Technology, Avi Publishing Co., Westport, 1964, Vol. II, pp. 467-478, 484-485.

<sup>1/</sup>Data on foreign trade are provided in Chapter VII.

<sup>2/</sup>The data in this section refer only to apples initially sold for commercial processing (including small quantities used for apple butter and baked apples). They do not include apples which have gone largely through the marketing system in fresh form but which are ultimately used for sauce or pies in the home or by bakeries or institutions.

<sup>3/</sup>The proportions by season were: 1954, 22.6%; '55, 20.5%; '56, 24.5%; '57, 20.5%; '58, 21.1%; '59, 21.4%; '60, 23.2%; '61, 23.6%; '62, 24.6%; and '63, 24.3%. A season or crop year represents the period from July 1 of the year indicated to June 30 of the following year.

for sauce and slices -- despite larger crops -- increased to about 24.2%. Most of the apples used for these purposes are tree-run, but some are sorts from a fresh grading operation.

Of the quantity processed into sauce and slices, by far the largest proportion was canned, while smaller proportions were frozen and dried. Over the ten-year period noted above, nearly 74% of the apples were canned, while about 12% were frozen and 14% dried. The proportion canned has increased in recent years (averaging nearly 78% during the 1963 season), while the proportion frozen has remained nearly constant, and the proportion dried has declined. Details are provided in Table 1.

Table 1. Utilization of U. S. Apple Production  
for Canning, Freezing, and Drying  
1954 to 1963 Seasons\*

Season	Utilization in Thousands of Bushels			
	Total	Canned	Frozen	Dried
1954	25,295	19,260	2,342	3,693
1955	21,815	15,884	2,041	3,890
1956	24,823	18,220	3,014	3,589
1957	24,460	17,423	2,528	4,509
1958	26,882	19,553	3,219	4,110
1959	27,206	19,131	4,268	3,807
1960	25,209	18,477	3,873	2,859
1961	29,868	22,707	3,308	3,853
1962	30,872	23,020	3,609	4,243
1963	30,466	23,738	3,493	3,235
Average	26,690	19,741	3,170	3,779

\*Excludes apples used for juice, cider, vinegar.

Source: The Fruit Situation, U. S. Department of Agriculture, August 1964, p. 26.

Unfortunately, the USDA data do not indicate the quantity used specifically for sauce or specifically for slices. The International Apple Association (IAA), however, makes some annual estimates which can be manipulated for this purpose.<sup>4/</sup> The IAA has estimated that during the 1963 season a total of nearly 31.2 million bushels of apples was used for sauce and slices (compared with a USDA estimate of 30.5 million bushels).<sup>5/</sup> Of this amount,

<sup>4/</sup>See "IAA Special Letter," September 3, 1964, pp. 1-4.

<sup>5/</sup>When reassembled another way, the IAA data suggest that 77.5% of the crop was canned (vs. a USDA estimate of 77.9%), 11.4% frozen (vs. 11.5%), and 11.1% dried (vs. 10.6%).

about 17.8 million bushels (or slightly over 57%) were used for sauce and 13.4 million (or nearly 43%) were used for slices. The sauce category was composed only of canned goods, while slices were made up of canned, frozen, and dried items.

Most of the apples used for sauce and slices are provided by seven States. During the 1963 season, New York growers supplied the largest portion of all the apples used for this purpose (22.9%), followed by Pennsylvania (16.5%), California (15.1%), Washington (11.6%), Virginia (11.1%), Michigan (9.1%), and West Virginia (6.0%).<sup>6/</sup> The sources for frozen and dried apples, however, did not follow this general pattern. Most of the apples for freezing came from New York and California, while nearly all of the dried apples came from Washington and California. More detailed information is presented in Table 2.

Table 2. Apples Sold for Canning, Freezing, and Drying by State, 1963 Season

<u>State</u>	<u>Utilization in Thousands of Bushels</u>			
	<u>Total</u>	<u>Canned</u>	<u>Frozen</u>	<u>Dried</u>
New York	6,985	5,780	1,125	80
Pennsylvania	5,020	5,000	20	--
Virginia	3,386	3,386	*	--
West Virginia	1,835	1,571	264	*
Michigan	2,760	3,080	680	--
Washington	3,525	1,225	110	2,190
California	4,615	2,476	1,174	965
Other	2,340	2,220	120	--
United States	30,466	23,738	3,493**	3,235**

\*Not reported here to avoid disclosure of individual operations.

\*\*Because of the exclusion noted above, this is a minimal figure.

Source: Fruits, Noncitrus, by States, 1962 and 1963, U. S. Department of Agriculture, Part II, July 1964, pp. 7-8.

## 2. Prices

Over the ten-year period from 1954 to 1963, the average annual price paid for canning and freezing apples was \$50.91/ton, while the drying price was

<sup>6/</sup>The proportion of the apple crop in any one State sold for these purposes is quite a different matter. During the 1963 season, representative proportions were: New York, 35%; Washington, 11%.



\$38.10/ton.<sup>7/</sup> Prices in individual years varied rather widely; this was particularly true of apples for drying.<sup>8/</sup> There did not appear to be any particular trend in either price series.<sup>9/</sup> Further details are presented in Table 3. A discussion of factors affecting the canning and freezing price will be found in Section 5 of this chapter.

Table 3. Average Season Prices Received by  
U. S. Growers for Canning and Freezing, and  
Drying Apples, 1954-1963 Seasons

<u>Season</u>	<u>Canning &amp; Freezing</u>	<u>Drying</u>
1954	\$68.90/ton	\$47.50/ton
1955	44.20	26.20
1956	66.60	44.50
1957	44.50	22.70
1958	35.80	19.50
1959	42.80	32.80
1960	57.40	46.20
1961	44.00	55.10
1962	49.20	49.80
1963	55.70	36.70
Average	\$50.91	\$38.10

Sources: Prices Received by Farmers, U. S. Department of Agriculture, Statistical Bulletin No. 322, September 1960, p. 22; "Noncitrus Fruit Prices by States," Supplement No. 1 to Agricultural Prices, USDA, June 1964, p. 4.

### 3. Value

Over the ten-year period from 1954 to 1963, the average farm value of apples sold for sauce and slices was nearly \$31.4 million. Most of this

<sup>7/</sup>The data did not provide a breakdown between prices paid for apples used for sauce and those used for slices.

<sup>8/</sup>Although it is not apparent in the statistics reported here, there were also significant variations in prices paid for canning and freezing apples of different sizes and -- to a lesser extent -- variety.

<sup>9/</sup>When, however, canning and freezing prices were deflated by the Wholesale Price Index and other factors taken into consideration, there was a downward movement in prices (E. C. Pasour and D. L. Oldenstadt, Farm Prices of Apples for Canning and Freezing, United States, 1951-61, U. S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 35, June 1963, p. iv).

was received from sales for canning and freezing (almost \$28.0 million), while a smaller proportion came from sales for drying (\$3.4 million). Total value fluctuated from a low of \$21.5 million to a high of \$39.9 million. Fluctuations in the individual series were equally severe (and perhaps even more so for dried apples). Further detail is presented in Table 4.

Table 4. Farm Value of Apples Sold for Canning and Freezing, and Drying, 1954-1963 Seasons

Season	Value in Millions of Dollars*		
	Total	Canning & Freezing	Drying
1954	\$39.9	\$35.7	\$4.2
1955	21.5	19.0	2.4
1956	37.8	33.9	3.8
1957	23.8	21.3	2.5
1958	21.5	19.6	1.9
1959	27.0	24.0	3.0
1960	34.0	30.8	3.2
1961	32.6	27.5	5.1
1962	36.5	31.4	5.1
1963	39.4	36.4	3.0
Average	\$31.4	\$28.0	\$3.4

\*Figures may not appear to add up or average out because of rounding.

Sources: Calculated from data provided in the following U. S. Department of Agriculture publications: The Fruit Situation, August 1964, p. 26; Prices Received by Farmers, Stat. Bulletin No. 322, September 1960, p. 22; "Noncitrus Fruit Prices by States," Supplement No. 1 to Agricultural Prices, June 1964, p. 4.

## B. Processor Level

Data on processed sauce and slices at the processor level are largely limited to the canned product. We have only limited information on the frozen and dried packs.

### 1. Canned Pack<sup>10/</sup>

Over the ten-year period encompassing the 1954 to 1963 seasons, the total pack of canned apple sauce and slices in the United States averaged 14.3

<sup>10/</sup>Daniel Swope and Stan Beebe of the National Cannery Association were of assistance in the preparation of this section.

million cases. Of this figure about 10.7 million cases (or 75%) were sauce and 3.6 million cases (or 25%) were slices.<sup>11/</sup>

The trend in production over the period was up. The increase, however, was more marked for sauce than it was for slices. Consequently, the proportion of total production represented by sauce increased steadily from 68% during the 1954 season to nearly 78% during the 1963 season. Details of the pack by season are presented in Table 5.

Table 5. U. S. Pack of Canned Apple Sauce and Slices, 1954-1963 Seasons ( $2\frac{1}{2}$  basis)

Season	Pack in Millions of Cases		
	Total	Sauce	Slices
1954	13.7	9.4	4.3
1955	11.6	8.3	3.3
1956	13.1	9.5	3.6
1957	12.2	8.9	3.4
1958	13.7	10.4	3.3
1959	15.1	11.4	3.7
1960	14.8	11.8	3.1
1961	16.2	12.6	3.7
1962	16.1	12.4	3.7
1963	16.7	13.0	3.7
Average	14.3	10.7	3.6

Source: Canned Food Statistics, 1963,  
National Cannery Association, pp. 68,  
69.

Production of canned sauce and slices was heavily concentrated in the four-State region of New York, Pennsylvania, Maryland, and Virginia. This area accounted for over 75% of sauce production and nearly 83% of slice production from 1954 to 1963. The Northwestern States of Washington, Oregon, and Idaho packed about 2% of the sauce and less than 10% of the slices. There did not seem to be any particularly marked trends in production of either item between the various States. A summary of the most recent five-year averages is presented in Table 6.<sup>12/</sup>

<sup>11/</sup>The sauce figure, and hence the total, is low in that it excludes sauce used in blends and baby food. The sliced figure does not include all of the spiced ring pack, but does include small quantities of baked and spiced whole apples.

<sup>12/</sup>It is not possible to set up a strictly comparable table for the full period because for the first five years Michigan sauce production was included in the "Other" category.



Table 6. Proportion of U. S. Canned Sauce and Slice Pack by Areas, 1959-1963 Seasons

<u>Area</u>	<u>Sauce</u>	<u>Slices</u>
New York	29.1%	23.4%
Appalachia <sup>1/</sup>	43.7	59.5
Michigan	7.8	*
Northwest <sup>2/</sup>	2.1	8.8
California	13.7	*
Other	3.5	8.3
<hr/>		
United States	100.0%	100.0%

\*Included in Other.

<sup>1/</sup>Pennsylvania, Maryland, and Virginia.

<sup>2/</sup>Washington, Oregon, and Idaho.

Source: Calculated from data provided in Canned Food Pack Statistics, 1963, National Canners Association, June 1964, pp. 46, 47.

Most of the canned sauce and slice is packed before December. Over the ten-year period, nearly 83% of the sauce and 72% of the slices were packed from August to November. October was the biggest single month, accounting for a little over a third of both packs. In both cases packing continued on through the spring but was essentially finished by May. Late season operation is more apt to be based on sorts from fresh grading operations than is true earlier. The slice pack tended to be put up a little later than the sauce pack (only 10% before October vs. 26% for sauce, but 14% in December vs. 9% for sauce). This may be related to the greater use of harder varieties, which mature later, for slices.

There is a substantial difference in the type and size of container used for sauce and slices. While much of the sauce pack is put up in retail-size containers, most of the slice pack is placed in larger wholesale-size units. For instance, during the 1963 season slightly over 53% of the sauce was put in No. 303 cans (17 oz.) and comparable glass jars (15-17 oz.) while about 75% of the slices were packed in No. 10 (109 oz.) cans.<sup>13/</sup> This suggests, as observation will verify, that the sauce market is largely a retail one while slices are much more of a wholesale item.

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<sup>13/</sup>The more detailed breakdown was: Sauce: 8 oz., 3.1%; No. 303 (17 oz.) and 15-17 oz. glass, 53.3%; 25 oz., 14.8%; No. 2<sup>1</sup>/<sub>2</sub> (30 oz.), 2.6%; 35 oz., 9.8%; No. 10 (109 oz.), 13.1%; Misc., 3.3%. In total, probably more than half of the sauce was put in glass. Slices: No. 2 (21 oz.), 16%; No. 10 (109 oz.), 75%; Misc., 9%. (Canned Food Pack Statistics 1963, p. 47, and unpublished data supplied by the National Canners Association.)

Price information comparable to that available at the farm level, unfortunately, is not available.<sup>14/</sup> The Bureau of Labor Statistics of the U. S. Department of Labor does, however, report wholesale prices and a price index for canned apple sauce (dozen can basis).<sup>15/</sup> Analysis of the indexes for the 1957 to 1962 seasons reveals that there was very little price variation during the year. As compared with an annual average index of 97.4, September and October ranked only slightly lower (-1.2 and -1.0 respectively) while March, April and May ranked slightly higher (+0.3, +0.6, and +0.7 respectively). These were the maximum variants. There did not appear to be any particular trend over the time period covered.

## 2. Frozen Pack<sup>16/</sup>

The United States pack of frozen apples is almost entirely limited to slices; practically no frozen sauce is produced. Within the slice category the frozen pack over the 1954 to 1963 period was slightly less than half of the canned pack (in terms of raw product equivalent).<sup>17/</sup> More specifically, the frozen pack averaged about 73 million pounds, varying from a low of 60 to a high of 87. No particular trend was evident. Estimates by year are reported in Table 7.

Table 7. U. S. Pack of Frozen Apple Slices, 1954-1963

<u>Calendar Year</u>	<u>Pack</u> (millions of lbs.)	<u>Calendar Year</u>	<u>Pack</u>
1954	60.1	1959	73.3
1955	72.8	1960	69.9
1956	87.0	1961	80.1
1957	69.2	1962	65.9
1958	67.4	1963	75.4

Sources: Annual issues of Agricultural Statistics and Frozen Food Pack Statistics, 1963, National Association of Frozen Food Packers, 1964, p. 6.

<sup>14/</sup>Wholesale prices are reported in at least one trade publication, but there is some question as to how systematically the data have been gathered -- and, therefore, how consistent they are every time. For the short run, however, they might be quite adequate.

<sup>15/</sup>This material is reported monthly in Wholesale Prices and Price Indexes, U. S. Department of Labor, Bureau of Labor Statistics (See Code No. 0241 01.05). A summary of the data since 1957 is presented in Canners Statistical Handbook, National Canners Association, 1964, p. 18-3.

<sup>16/</sup>Jerry Webster of the National Association of Frozen Food Packers was of assistance in preparing this section.

<sup>17/</sup>In making this comparison it was assumed that one pound of frozen product (packed one part sugar to five parts fruit) was the equivalent of 1.67 pounds of raw product. For canned slices, one case of 24 No. 2½ cans was assumed to be equal 67.2 pounds of raw product (Pasour and Oldenstadt, op. cit., p. 9, fn. 6).

Over the above period, the pack was concentrated as follows: Northeast, 35.6%; South, 9.1%; Midwest, 28.6%; and West, 26.8%. From 1961 to 1963 there was a sharp increase in the proportion packed in the South, and decrease in the proportion packed in the Midwest.

Virtually all of the frozen pack is sold at the wholesale level, mainly for reprocessing.

### 3. Dried Pack

At present the pack of dried apples, like the frozen, is essentially limited to slices. Over the 1954 to 1963 period the dried pack was about three quarters as large as that of canned slices and half again as large as the frozen slice pack (in terms of raw product equivalent).<sup>18/</sup> The finished pack -- derived from utilization estimates -- averaged about 22.7 million pounds. Estimates by year are provided in Table 8.

Table 8. Estimated U. S. Pack of Dried  
Apple Slices, 1954-1963

<u>Season</u>	<u>Pack</u> (millions of lbs.)	<u>Season</u>	<u>Pack</u>
1954	22.2	1959	22.8
1955	23.3	1960	17.2
1956	21.5	1961	23.1
1957	27.1	1962	25.5
1958	24.7	1963	19.4

Source: The Fruit Situation, U. S. Department of  
Agriculture, August 1964, p. 28.

Most of the pack is put up in California and Washington. A large share of the dried slices is sold at the wholesale level. A substantial quantity, however, is exported and some of this in turn is sold at retail.<sup>19/</sup>

### 4. Comparative Costs

There is very little information available on the costs of processing and marketing sauce or slices in any of their forms. Beyond several specialized studies which reflect on some phase of processing cost or of a new technology (to be noted in subsequent chapters), no general studies appear to have been conducted since the late 1940's -- and then the only work was on slices.

The latter study was a comprehensive analysis of the cost of processing and storing various forms of apple slices on the West Coast and of transporting

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<sup>18/</sup>Comparison based on assumption that one pound of dried product is the equivalent of eight pounds of raw fruit.

<sup>19/</sup>Details on recent exports are provided in Chapter VII.



them to Chicago.<sup>20/</sup> The data applied to 1948 and 1949 and so are quite dated now. And though technologies and costs have changed since then, the general relationships that existed may still be of interest.<sup>21/</sup>

<u>Cost Range</u>	<u>Processing</u>	<u>Storage</u> (6 months)	<u>Transportation</u>
Most expensive	freezing	frozen	frozen
-	canning	dehydrofrozen	canned
-	dehydrocanning	canned	dehydrofrozen
-	dehydrofreezing	dehydrocanned	dehydrocanned
-	drying	vacuum dried	dried
Least expensive	vacuum dried	dried	vacuum dried

A comprehensive study of the costs of establishing and operating apple processing facilities was initiated at Washington State University in the fall of 1964.<sup>22/</sup>

### C. Retail Level

In the previous section we indicated that apple sauce tended to be more of a retail item than slices. This is borne out in a recent national study of canned fruit sales.<sup>23/</sup> Nationally, sauce accounted for 11.5% of canned fruit sales -- higher than any other single canned item -- while slices and associated items (excluding pie mix) totaled only 1.2%. Sauce sales were highest in the New England, Mid-Atlantic, Midwest, and Pacific regions; in fact, sauce sales were higher than any other single fruit item in these areas (the number of cases moved and the number of brands and sizes were also highest). On the other hand, sauce sales were considerably smaller in the Southeast and particularly small in the Southwest. Curiously, sales of slices and other canned items were highest where sauce sales were the lowest. While the average gross margin on sauce was below the average for all canned items, the average margin for slices was above and, in fact, was the second highest -- principally because of a particularly high margin in the Pacific area. Detailed results of the study are presented in Table 9.

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<sup>20/</sup>Vern F. Kaufman, "Costs and Methods for Pie-Stock Apples," Food Engineering, December 1951 (Vol. 22, No. 12), pp. 97-105.

<sup>21/</sup>The costs reported are those on the basis of 100 lbs. of fresh apples (p. 105). The processing cost includes container but excludes selling and brokerage costs, and profit. The frozen item refers to one with sugar added (1:5).

<sup>22/</sup>This project is part of a more general study of the feasibility of apple processing in Washington. It is being conducted by Earl Franklin and W. A. Rehberg of the Dept. of Agricultural Economics. Several preliminary background reports have been issued: U. S. Apple Production Trends, Circular 444; Regional Apple Supply-Consumption Relationships, Circular 445.

<sup>23/</sup>Chain Store Age, Supermarket Sales Manual Issue, Mid-July 1964, pp. 52-56.

Table 9. Sales Performance of Canned Apple Sauce and Slices in 2,632 U. S. Chain Supermarkets, 1963

I. <u>Apple Sauce</u> <sup>1/</sup>	Percent of Canned Fruit Sales	Weekly Cases Moved	Brands/ Sizes	Avg. Gross Margin
New England	15.8%*	11.1*	13*	20.8%
Mid-Atlantic	15.7*	16.1*	17*	22.7
Midwest	13.9*	19.5*	12*	24.0
Southeast	8.2	9.6	8	21.7
Southwest	4.4	4.4	9	25.3
Pacific	11.0*	13.9*	11	26.5
United States	11.5%*		12*	23.5%
II. <u>Apple Slices</u> <sup>2/</sup>				
New England	0.8%	0.5	4	27.1%
Mid-Atlantic	1.0	0.7	4	25.8
Midwest	0.7	0.7	3	26.0
Southeast	1.9	1.3	4	25.9
Southwest	2.2	1.4	7	24.2
Pacific	0.5	0.3	2	35.0*
United States	1.2%		4	27.3%**

Notes:

\*Highest in category. This means that apple sauce ranked higher than any other single pack (such as sliced peaches, crushed pineapple, fruit cocktail, etc.). All apple products (sauce, slices, etc.) are not compared against, say, all peach products. If this were done, peaches and pineapple as groups would rank ahead of apple products.

\*\*Third highest.

<sup>1/</sup>Includes regular apple sauce and apple sauce blends (apple-cranberry, and apple-raspberry).

<sup>2/</sup>Also includes baked apples, spiced apple rings, and crabapples. Does not include apple pie mix.

Source: Chain Store Age, Supermarket Sales Manual Issue, Mid-July 1964, pp. 52-56.

These data indicate that a little over 90% of the retail canned apple sales were made up of apple sauce; less than 10% were slices and other apple products (excluding pie mix). Similar results were provided by a study in Philadelphia in 1956. The Philadelphia study revealed that 89% of canned apple sales were sauce. The remaining 11% was made up as follows: slices, 4.1%; baked apples, 2.9%; pie mix, 2.5%; and spiced crabapples, 1.4%.<sup>24/</sup>

The sales pattern for both sauce and slices during the year is relatively uniform. Studies of retail purchases in Philadelphia and East Lansing suggest that if there is any low point, it would appear to be in the summer or early fall; if there is a high point, it is in winter or spring.<sup>25/</sup>

Systematic national information on retail prices for sauce and slices is not freely available.<sup>26/</sup> While the Bureau of Labor Statistics of the U. S. Department of Labor reports retail prices of some canned fruits (including canned pears), apples are not included. This is because the few fruits to be covered are selected on the basis of a statistical sample rather than solely on economic value.<sup>27/</sup> Quarterly data on sauce have been collected for the Department of Agriculture from two cities, Detroit and Pittsburgh, on a quarterly basis since 1956 but are not published.<sup>28/</sup> The only other information on retail prices is reported in the next section.

#### D. Consumer Level

In order to facilitate interpretation of the preceding material, we turn to an examination of per capita consumption data. Most of the data are regularly reported by the U. S. Department of Agriculture.<sup>29/</sup>

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<sup>24/</sup>Retail Sales Analysis of Canned Fruits and Juices (The Philadelphia Project), National Cannery Association, Report No. 4 [1957], p. 18.

<sup>25/</sup>Seasonal Patterns in Retail Sales of Canned Foods (The Philadelphia Project), National Cannery Association, Report No. 5 [1958], p. 10; Dana G. Dalrymple, Consumer Purchases of Fresh and Processed Apples, Michigan State University, Dept. of Agricultural Economics. Ag. Econ. 806, January 1961, pp. 12-13.

<sup>26/</sup>Such information could, however, probably be obtained on a contractual basis through one of several national market research organizations.

<sup>27/</sup>Based on a conversation with Miss Winifred Stone, Bureau of Labor Statistics, U. S. Department of Labor, December 22, 1964.

<sup>28/</sup>A file of this data is maintained in the Horticultural Crops Branch of the Economic Research Service of the U. S. Department of Agriculture.

<sup>29/</sup>Actually, "consumption" as used here represents per capita disappearance of commercially processed stocks. The data do not take into account the consumption of (1) sauce blends or baby food or (2) fresh apples which have been made into sauce or slices in the home, bakeries, or institutions.



## 1. National Data

The U. S. Department of Agriculture estimates are reported in terms of farm weight equivalent and product weight.<sup>30/</sup> The farm weight figure is obtained by converting actual pack figures back to raw apple equivalent. The product weight is based on, of course, the commercially processed pack.

a. Farm Weight Equivalent. Consumption of processed sauce and slices equalled about six pounds of fresh apples per person per year from 1954 to 1963. This represented about 22% of all apple consumption.<sup>31/</sup> Over the period, processed consumption increased while fresh consumption decreased. Processed consumption, therefore, represented an increasing proportion of all apple consumption (e.g., from about 19% in 1954 to nearly 25% in 1963).<sup>32/</sup> Of total processed consumption, the largest proportion (76%) was made up of canned products, with lesser quantities being dried and frozen. Consumption of the canned items increased while frozen held about steady and dried declined slightly. Details are provided in Table 10.

Canned apples represented about 16.5% of all canned fruit consumption from 1954 to 1963. The proportion represented by apples increased more or less steadily during the period (from 14% in 1954 to 18% in 1963).

b. Product Weight. When consumption is expressed in product weight, the per capita figures are, of course, smaller than when raw fruit weights are used. Average total sauce and slice consumption, for instance, was nearly 3.7 lbs. during the 1954 to 1963 period (as contrasted with 6 lbs. in farm weight equivalents). The biggest decrease, of course, was for dried apples. The trends were the same as those for the farm-weight category. Details are provided in Table 11.

Within the canned group, sauce accounted for nearly 78% of consumption while slices totaled over 22%. As noted previously, the proportion accounted for by sauce increased from 1954 to 1963 (e.g., from 72% in 1954 to 81% in 1963) at the expense of slices.

c. Home Production. Although most of the apple sauce and slices used in the home is purchased in processed form, some is unquestionably

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<sup>30/</sup>These figures are reported annually in the August issue of the Fruit Situation. The data used in this section were taken from the 1964 issue (pp. 28, 34).

<sup>31/</sup>This is slightly less than the utilized figure of 22.6% presented in Section A of this chapter. Differences may be ascribed to variations in: (1) coverage (the utilization figures allow for use in baby food and blends) and (2) reporting periods (calendar years are used here whereas crop years were used in previous sections).

<sup>32/</sup>Some of the apparent increase in processed consumption may represent a substitution for home canning (what little information that is available on home processing is presented in Section c which follows).

Table 10. U. S. Per Capita Consumption of Apple Sauce and Slices  
1954-1963 (Farm Weight Equivalent, Lbs.)

Calendar Year	Total Consumption	Form		
		Canned	Frozen	Dried
1954	5.0	3.6	0.5	0.9
1955	5.7	4.1	0.7	0.9
1956	6.1	4.4	0.9	0.8
1957	5.7	4.4	0.6	0.7
1958	6.1	4.7	0.7	0.7
1959	6.0	4.5	0.7	0.8
1960	6.3	4.9	0.7	0.7
1961	6.3	5.0	0.6	0.7
1962	6.0	4.8	0.5	0.7
1963	6.7	5.2	0.7	0.8
Average	5.99	4.56	0.66	0.77

Source: The Fruit Situation, U. S. Department of Agriculture, August 1964, p. 34.

Table 11. U. S. Per Capita Consumption of Apple Sauce and Slices  
1954-1963 (Product Weight, Lbs.)

Calendar Year	Total Consumption	Form		
		Canned	Frozen	Dried
1954	2.93	2.50	0.31	0.12
1955	3.34	2.82	0.41	0.11
1956	3.64	3.05	0.51	0.08
1957	3.46	3.04	0.34	0.08
1958	3.76	3.27	0.39	0.10
1959	3.65	3.17	0.39	0.09
1960	3.92	3.43	0.40	0.09
1961	4.01	3.56	0.37	0.08
1962	3.86	3.43	0.32	0.11
1963	4.16	3.67	0.41	0.08
Average	3.67	3.19	0.39	0.09

Source: The Fruit Situation, U. S. Department of Agriculture, August 1964, p. 28.



still made from fresh apples. On a national level in 1950, 58% of the consumers who bought canned apple sauce reported that they used homemade sauce as well.<sup>33/</sup> Similarly, in New York in 1960, 35% of the homemakers contacted said that they made their own sauce.<sup>34/</sup> A national study of several thousand consumers conducted in 1963/64 indicated that 14% used only homemade sauce while 36% used homemade and canned; of those who had used canned sauce, 45% preferred homemade sauce.<sup>35/</sup>

While these studies do not indicate how much sauce was homemade from fresh apples, they at least suggest that it was not an infrequent or unimportant occurrence. This, in turn, implies that in terms of the ultimate form of consumption the preceding figures may understate the actual situation. The importance of home production, however, has probably decreased over the years as an increasing proportion has been purchased in processed form.

## 2. Local Data

More detailed consumption estimates are available only on a local basis. The Michigan State University Consumer Panel, which was in operation during the middle fifties, provides a unique picture of actual consumer purchases -- including quantity of purchase, price paid per pound, and expenditure.<sup>36/</sup> This information is reported in detail in Table 12.

Over the five-year period from 1953 to 1957, the average annual purchase of sauce and slices was about 2.9 lbs. per person. Nearly 84% of this (or over 2.4 lbs.) was made up of sauce while the remaining 16% (nearly 0.5 lbs.) was made up of slices. The sauce figure was composed of regular canned sauce and sauce baby food. The slice figure included the usual canned, frozen, and dried categories plus canned pie mix.<sup>37/</sup> This is the only place where baby food consumption has been reported and it may be noted that it equalled nearly 15% of regular sauce purchases.

When comparisons are made with the previously cited USDA figures for approximately the same period,<sup>38/</sup> it may be seen that the consumption of

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<sup>33/</sup>Consumer Preferences Regarding Apples and Winter Pears, U. S. Department of Agriculture, Agriculture Information Bulletin 19, 1950, pp. 14, 15.

<sup>34/</sup>Douglas J. Dalrymple, Fruit Merchandising Experiments: Apple Sauce, Apples, Sour Cherries, Peaches, Cornell University, Dept. of Agricultural Economics, A. E. Res. 38, July 1960, p. 8.

<sup>35/</sup>L. Yvonne Clayton, Homemakers' Use of and Opinions About Selected Fruits and Fruit Products, U. S. Department of Agriculture, Statistical Reporting Service, SRS-6, May 1965, pp. 7, 11.

<sup>36/</sup>These data were originally reported by Dana G. Dalrymple, Consumer Purchases of Fresh and Processed Apples, Michigan State University, Dept. of Agricultural Economics, Ag. Econ. 806, January 1961, 16 pp.

<sup>37/</sup>Unlike the USDA figure it does not include slices which were consumed in reprocessed form such as in pies, cakes, etc.

<sup>38/</sup>The panel figures were reported on a crop year basis; the USDA calendar year figures were averaged for the 1953-58 period.

Table 12. Annual Per Capita Purchases of Apple Sauce and Slices  
Michigan State Consumer Panel, Lansing  
1953-1957 Crop Years

	Purchase	Average Annual Price/lb.*	Expenditure
<u>Apple Sauce</u>	2.442/lb.	--	44.67¢
Canned, regular <sup>1/</sup>	2.132	15.80¢	34.67
Canned baby food <sup>2/</sup>	0.310	32.24	10.00
<u>Apple Slices</u>	0.476	--	9.36
Canned <sup>3/</sup>	0.333	19.76	6.31
Canned pie mix <sup>4/</sup>	0.137	21.17	2.87
Frozen	0.004	22.40	0.08
Dried	0.002	56.99	0.10
Total	2.918/lbs.		54.03¢

Notes:

\*1954-57 crop years.

<sup>1/</sup>Includes some apple butter.

<sup>2/</sup>Excludes blend with apricots.

<sup>3/</sup>Includes some whole baked apples.

<sup>4/</sup>Includes some dried mixes.

Source:

Dana G. Dalrymple, Consumer Purchases of Fresh and Processed Apples, Michigan State University, Dept. of Agricultural Economics, Ag. Econ. 806, January 1961, pp. 3-5.

regular sauce was nearly the same (2.13 lbs. for the panel vs. 2.09 lbs. for the United States).<sup>39/</sup> It is not possible to make a similar comparison for slices.<sup>40/</sup>

Prices paid varied from a low of nearly 16¢/lb. for regular canned sauce to a high of 57¢/lb. for dried apples. Canned baby food sauce was over twice as expensive per pound as was regular sauce. Canned pie mix was slightly more expensive than regular slices, while frozen slices were more expensive than both.

<sup>39/</sup>This comparison is made for regular sauce and excludes baby food sauce. The panel figure, unfortunately, includes apple butter; exclusion of this item would reduce the sauce figure. On the other hand, it does not include gifts and "home grown" (which presumably may include some homemade sauce).

<sup>40/</sup>It may be interesting to note, though, that the panel figure is less than half of the USDA figure -- reflecting the substantial portion of slices consumed in prepared form (pie, etc.).

The total expenditure for sauce and slices was approximately 54¢ per person per year. Nearly 83% of this came from sauce and over 17% from slices.

## E. Price Analyses

In closing this chapter on Economic Statistics, we turn briefly to a discussion of some price analysis work which has been done on canning and freezing apples. While this is not the easiest of subjects, it is important for an understanding of the basic economic structure of the industry. It also forms a basis for bargaining between growers and processors. We shall cover only some of the high points.

### 1. Utilization and Prices at the Farm Level

a. Utilization. It appears that the most important factor influencing the quantity of apples utilized for canning and freezing in the past has been the size of the overall apple crop in the East. A recent study indicated that during the 1946 to 1960 period eastern production explained 62% of the variations in canning and freezing utilization.<sup>41/</sup> Another investigation, covering the 1947 to 1962 period, suggested a comparable figure of 66%.<sup>42/</sup> Production in other areas was not found to be particularly important. This relationship appears logical because of the concentration of processing plants in the East.

The role of other variables is less clear. Although one study found fresh and canning prices to play a significant role in explaining processing price during the 1934 to 1953 period (excluding 1942 to 1946),<sup>43/</sup> other investigators note essentially no correlation between price and utilization.<sup>44/</sup> A similar disparity of results was found with respect to canned carryover. It is not entirely clear why such a disparity in results exists; but it may be related to the different period covered, the different data used, and differing statistical techniques.

b. Prices. The most important factors in the determination of canning and freezing price appear to be (1) carryover of processed stocks, (2) size of total crop, and (3) fresh apple price.

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<sup>41/</sup>Dana G. Dalrymple, "Economic Aspects of Apple Marketing in the United States," Michigan State University, Dept. of Agricultural Economics, Ph. D. dissertation, 1962, p. 64.

<sup>42/</sup>William G. Tomek, An Analysis of Changes in the Utilization of Apples in the United States, Cornell University, Dept. of Agricultural Economics, A. E. Res. 137, December 1963, p. 31.

<sup>43/</sup>G. E. Brandow, A Statistical Analysis of Apple Supply and Demand, Pennsylvania State University, Dept. of Agricultural Economics and Rural Sociology, AE & RS No. 2, January 1956, pp. 9, 11, 12.

<sup>44/</sup>Dalrymple, op. cit. (1962), pp. 64-65; Tomek, loc. cit.



Studies of past prices have used carryover and eastern production.<sup>45/</sup> When one economist, for instance, analyzed prices for the 1934 to 1953 period (excluding 1942-46) he utilized both of these, plus the wholesale food price and military purchases and exports, to explain 90% of the variation in the United States canning price.<sup>46/</sup>

In order to predict prices at the beginning of the season, a slightly different approach seems to be desirable. A Michigan study in 1962 indicated that it is possible to estimate season prices in the early fall by making use of (1) the August 1 carryover, (2) the September or October crop estimate, and (3) the average September or October fresh prices.<sup>47/</sup> When the September data were used, it was possible to explain 94.5% of the variation in past canning and freezing prices; use of the October data explained 93% of the variation.

This system was subsequently expanded and refined by other economists.<sup>48/</sup> They extended the analysis to cover the months of July and August. They refined the analysis by: making use of stocks as of the beginning of each month, converting the crop and stock statistics to a per capita basis, deflating prices by the Wholesale Price Index, using a more recent time period (1951-61), and adding a trend variable. While their results were similar for September and October, they indicated that good estimates could also be made with July and August data. Like the earlier study, they found the effect of processed stocks to be particularly significant in all months, while the crop estimate became less important as the season progressed. Fresh apple price, however, was more significant in August than earlier or later in the season. Trend was significant only in August and September.

Detailed findings of both studies are summarized in Table 13.

## 2. Price and Cross Elasticities of Demand

One commonly used technique for expressing the nature of the demand relationship for a product is through its price or cross elasticity of demand. The elasticity indicates the proportional change in quantity purchased of a product that might be expected from a given proportional change in price of, respectively, that product or related products.

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<sup>45/</sup>In 1963, Tomek reported that for the 1947-62 period, eastern production explained 58% of the variation of canning and freezing price, while August 1 carryover explained 44% (loc. cit.). Dalrymple's work suggested a less significant role for eastern production (op. cit., p. 294).

<sup>46/</sup>Brandow, op. cit., pp. 22, 23.

<sup>47/</sup>Dalrymple, op. cit. (1962), pp. 296-297 (First differences of logs were used). A discussion of these variables is presented on pp. 292-295.

<sup>48/</sup>E. C. Pasour, Jr., and D. L. Oldenstadt, Farm Prices of Apples for Canning and Freezing, United States, 1951-61, U. S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 35, June 1963, 20 pp.

Table 13. Variables Associated with U. S. Farm Price of Canning and Freezing Apples<sup>1/</sup>

1. Dalrymple (1947-60)

<u>Variable</u>	<u>September</u>	<u>October</u>
Processed stocks <sup>2/</sup>	*	*
Crop estimate	**	#
Fresh apple price	*	*
Price variation explained ( $R^2$ )	94.5%	93%

2. Oldenstadt and Pasour (1951-61)

<u>Variable</u>	<u>July</u>	<u>August</u>	<u>September</u>	<u>October</u>
Processed stocks <sup>3/</sup>	*	*	*	*
Crop estimate	*	*	#	-
Fresh apple price	#	*	**	**
Trend	-	*	*	-
Price variation explained ( $R^2$ )	91%	92%	94%	93%

Code

- \* Very significant (significant at .05 level)
- \*\* Significant (significant at .10 level)
- # Less significant (significant at .20 level)
- Not significant (not significant at .20 level)

Notes

<sup>1/</sup>Variables which are measurable on a monthly basis and which can be used to predict price.

<sup>2/</sup>August 1 carryover.

<sup>3/</sup>Carryover as of the first of the month, per capita terms.

Sources

Dana G. Dalrymple, "Economic Aspects of Apple Marketing in the United States," Michigan State University, Dept. of Agricultural Economics, Ph. D. dissertation, 1962, p. 296.

E. C. Pasour, Jr., and D. L. Oldenstadt, Farm Prices of Apples for Canning and Freezing, United States, 1951-61, U. S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 35, June 1963, p. 19.

a. Price Elasticity. If, for a given price change, the quantity purchased changes a greater amount in the opposite direction, we say that the demand is elastic; if the quantity changes a smaller amount in the opposite direction, we say that demand is inelastic.<sup>49/</sup>

While many studies have reported price elasticities for fresh apples, processed apples have received relatively little attention. And in the work that has been done, there is some variation in the figure obtained. For instance, analyses of annual elasticities for canning and freezing apples at the farm level have provided results ranging from -0.13 to -0.68; the actual figure is probably somewhere between.<sup>50/</sup> The one study of demand at retail provides an aggregate estimate of -5.44 for apple sauce over a five-year period in Lansing, Michigan, and yearly estimates which vary from -2.05 to -6.71 depending on crop size.<sup>51/</sup>

Thus, while precise figures have not been obtained, it appears that the demand for canning and freezing apples at the farm level is quite inelastic, while the demand for apple sauce at retail is quite elastic.<sup>52/</sup> The greater elasticity at retail is to be expected.<sup>53/</sup>

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<sup>49/</sup>For example, if a 1.0% increase in price leads to a decrease of 1.5% in quantity purchased, the demand is elastic; if the quantity purchased decreases by 0.5%, the demand is inelastic. In the former case the elasticity is reported as -1.5; in the latter case as -0.5.

<sup>50/</sup>Specific results were as follows: (1) Using least squares with quantity dependent, Brandow obtained a figure of -0.13, and Tomek a figure of -0.17; when price was dependent and a transformation made, Brandow's estimate increased to -0.68, exceeding an estimate of -0.59 for New York by Bartter. (2) Using simultaneous equations, Brandow estimated elasticity to be -0.21 (limited information, single equation), while Tomek obtained figures of -0.57 and -0.45 (two-stage least squares). (Brandow, op. cit., pp. 2, 20; Tomek, op. cit., p. 24; Lynn M. Bartter, Effects of Apple Supply Management Programs in New York State, Cornell University, Dept. of Agricultural Economics, A. E. Res. 62, April 1961, p. 3.)

<sup>51/</sup>Dalrymple, op. cit. (1962), pp. 231-236. As these figures were based on weekly data, they may be somewhat higher than those obtained from annual data. A discussion of estimates obtained for less than yearly aggregates is provided on pp. 236-240.

<sup>52/</sup>A discussion of the implications of these and other elasticities with respect to diversion programs is outside the scope of this report, but is provided in Dalrymple, op. cit. (1962), pp. 245-254, 308-330. The latter section has been reproduced in several mimeographs (D-4, D-5) which are available from the author. An analysis of more recent work is provided in another paper, "Some Economic Considerations in Assessing Diversion Programs for Apples" (D-9, 1964, 8 pp.).

<sup>53/</sup>For a discussion of this point see Dana G. Dalrymple, On the Nature of Marketing Margins, Michigan State University, Dept. of Agricultural Economics, Ag. Econ. 824, April 1961, pp. 2-4.



b. Cross Elasticity. A certain amount of substitution might be expected between fresh and processed apples at retail -- particularly between fresh apples purchased for home processing and canned sauce or slices. One way of expressing this relationship is through the cross elasticity of demand. Although such a coefficient has been derived by introducing artificially constructed data,<sup>54/</sup> attempts using actual retail data have not produced significant results.<sup>55/</sup> No studies are known to have been made of the cross elasticity with respect to other fruits.

### III. APPLE SAUCE

Having presented a general picture of the processing industry, we now turn to a more detailed examination of recent developments in the production and marketing of apple sauce. We start by discussing the thorny question of product evaluation. This is followed by a review of studies pertaining to raw product and preparation techniques. We then focus our attention on the individual types of sauce pack: canned, frozen, and dried.

#### A. Product Evaluation

A key area for any discussion of processing and marketing of apple sauce is that of product quality. Quality is largely evaluated on a subjective basis. Hence, opinions on what makes a good quality sauce will vary with the group making the evaluation.

##### 1. Grade Standards

In order to provide some objective criterion for sauce quality, objective grade standards have been established by the U. S. Department of Agriculture in consultation with industry groups. Their use is optional. The standards give equal weight to (1) flavor, (2) consistency, (3) texture, (4) color, and (5) defects.<sup>1/</sup> The relative importance of each of these factors, however, appears to be rated quite differently by some industry members, buyers, and consumers.

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<sup>54/</sup>William F. Drew, "Demand and Spatial Equilibrium Models for Fresh Apples in the United States," Vanderbilt University, Dept. of Economics, Ph. D. dissertation, 1961, pp. 213-214. More specifically, it appeared that an increase of 1% in the price of canned apples was associated with an increase of 0.32% in fresh apple purchases; conversely, a 1% increase in the fresh price was associated with a 0.67% increase in canned purchases.

<sup>55/</sup>Dalrymple, op. cit. (1962), p. 255 (fn. 41).

<sup>1/</sup>United States Standards for Grades of Canned Apple Sauce, U. S. Department of Agriculture, Agricultural Marketing Service, effective September 18, 1950, 4 pp. According to the preface "these standards are designed to serve as a convenient basis for sales, for establishing quality control programs, and for determining loan values." The grades are normally not printed on the can, but the grade of the pack is known and used at the wholesale level. Federal purchases are made on the basis of grade.

--Industry. In a Maryland study conducted over three seasons (1955-1957) an industry panel rated various blends of canned apple sauce according to the first four grade factors noted above. The panel was composed of processors, USDA inspectors, and food technologists. Of the overall variations in grade, 37% were accounted for by flavor, 6% by consistency, 12% by texture and 45% by color.<sup>2/</sup>

--Chain Store Buyers. In the final season of the above study, chain store buyers were also asked to evaluate sauce blends. Of the total variation in the grades they assigned, only 1% was accounted for by flavor and 3% by consistency. On the other hand, texture accounted for 25% and color for a massive 71%.<sup>3/</sup>

--Consumers. In New York State, 652 consumers were contacted in 1959 regarding their preferences for sauce. When asked for their reasons for preferring a particular sauce, 61% indicated flavor, 23% consistency and texture, 3% color, and 0% defects.<sup>4/</sup>

Obviously, then, the three groups laid quite different emphasis on the various grade factors in selecting a preferred sauce. For comparison purposes, the results may be roughly summarized as follows:

	<u>Industry</u>	<u>Chain Buyer</u>	<u>Consumer</u>
Flavor	37%	1%	61%
Consistency	6	3 :	23
Texture	12	25 :	3
Color	45	71	

The differences were most pronounced as regards flavor and color. Chain buyers and consumers represented diametrically opposed opinions on these points, with industry falling in between.

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<sup>2/</sup>Robert C. Wiley and Verner Toldby, "Factors Affecting the Quality of Canned Apple Sauce," Proceedings, American Society for Horticultural Science, 1960 (Vol. 76), pp. 112-123, especially pp. 119, 120, 122, 123. This project, like the other Maryland studies reported in this bulletin, was done under contract with the Eastern Utilization Research and Development Division of the U. S. Department of Agriculture.

<sup>3/</sup>Ibid., pp. 120, 123. The overall R<sup>2</sup>, however, was lower for this group than for the industry panel.

<sup>4/</sup>Douglas J. Dalrymple, "A Study of Consumer Preference for Apple Sauce Using the Two-Visit Interview Technique," Journal of Farm Economics, August 1961, pp. 691-697. A less technical and more detailed presentation is provided in Fruit Merchandising Experiments: Apple Sauce, Apples, Sour Cherries, Peaches, Cornell University, Dept. of Agricultural Economics, A. E. Res. 38, July 1960, pp. 1-9. The author adds that the housewife may have tended to indicate flavor because it was the simplest and most obvious reply; she may not place so much emphasis on it in actually making a selection (letter, February 23, 1965).



In no case were the factors given equal weight as they are in the U. S. grades. Moreover, the total importance given to consistency and texture varied only from 18 to 28%,<sup>5/</sup> while flavor and color rated from 64 to 82%. Obviously, the latter were considered most important by all groups (though there was a sharp difference as to whether flavor or color was more important). These results would seem, then, to be at variance with the present system of equal weighing of the factors.

It may be of related interest to note that when New York consumers were asked to select preferred sauces from eight unmarked commercial samples representing U. S. grades A, C, and Substandard, the only significant preferences were for three which had received grades C or Substandard.<sup>6/</sup>

## 2. Varietal Considerations

Just as producers and consumers have different opinions on grade factors, they have different viewpoints on the importance of variety. Yet there is a definite relation between variety and grade -- and this relationship might tend to limit the use of certain varieties. We shall first look at the industry viewpoint and then turn to the consumer.

a. Industry. In the Maryland study noted above, an industry panel was asked to grade sauce (using the foregoing factors) made from different varieties. In terms of overall grade, the varieties were ranked as follows, in decreasing order: Golden Delicious, York, Jonathan, Stayman, Rome Beauty, and Northwest Greening. When varieties were blended, an equal blend of York and Jonathan received the highest score.<sup>7/</sup>

In terms of trade practice, there are certain varieties which are usually considered best for processing.<sup>8/</sup> A recent survey of six processors in New York, for instance, revealed that the following varieties were preferred for sauce (in decreasing order of preference): R. I. Greening, Twenty Ounce, Spy, and Baldwin.<sup>9/</sup> While such varieties are desired (and receive

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<sup>5/</sup>While consistency and texture were not rated highly here, they are probably considered important by operators of public feeding establishments who do not want a product that runs when placed on a plate.

<sup>6/</sup>Dalrymple, loc. cit.

<sup>7/</sup>Wiley and Toldby, op. cit., pp. 115-118.

<sup>8/</sup>The reasons for this preference will be discussed in greater detail in a subsequent section.

<sup>9/</sup>"Apple Varieties We Like," New York State Horticultural Society Newsletter, February 1965, p. 5 (based on a study by the New York State Canners and Freezers Association). For a more general listing (which includes apples for slicing), see Charles H. Mahoney and Edwin A. Crosby, Raw Product Quality Specifications of Apples for Canning, National Canners Association, October 1956, pp. 3, 4.

a premium) they are often not available in sufficient quantities.<sup>10/</sup> In such a case, processors find it necessary to turn to fresh market varieties such as McIntosh.<sup>11/</sup> It is quite possible to blend varieties in making a sauce and, in fact, the final pack nearly always represents a blend.

b. Consumer. Three consumer-oriented studies have been conducted which shed some rather different light on the question of varieties.

A taste panel conducted in Pennsylvania in the late 1950's involved 35 different sauce blends. It was found that blends containing Staymans or Romes in some proportion were preferred; surprisingly, those with Yorks or Baldwins were least preferred.<sup>12/</sup>

In a New York study in 1960, a number of different sauce blends were evaluated by 720 consumers. What might be considered the check blend was made up of three processing varieties (Baldwin, R. I. Greening, and Spy). The test blends included variable qualities of McIntosh, varying from 25 to 50%. A third test blend was composed entirely of McIntosh. The only significant preference expressed by the homemakers was for the blend with 25% McIntosh.<sup>13/</sup>

A subsequent taste panel study conducted in Detroit, Michigan, indicated that a sauce that was made from Greenings was not significantly preferred over sauces made from fresh market varieties such as Red Delicious, Jonathan, or McIntosh.<sup>14/</sup>

Consumer studies, then, suggest that the variety may not be particularly important. Furthermore, where a preference was expressed, it appeared to

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<sup>10/</sup>A New York study in 1959 revealed that sauce and slice processors desired 20 times more Twenty Ounce and 18 times as many Spys as they actually received; conversely, they received 53 times more McIntosh and 71 times more miscellaneous varieties than they desired (M. L. Beckford, A Survey of Buyers of Apples /for Processing/ in Western New York, Cornell University, Dept. of Agricultural Economics, August 1960, pp. 3, 4).

<sup>11/</sup>If a processor has a limited stock of processing varieties, he is more apt to use them for slices. Sauce, as noted, can be made of a blend of varieties; a slice pack generally cannot.

<sup>12/</sup>F. B. Thomas and C. M. Ritter, Varietal Influences on Quality of Apple Sauce Blends, Pennsylvania State University, Agricultural Experiment Station, Progress Report 193, 1958, 4 pp.

<sup>13/</sup>Dalrymple, op. cit.

<sup>14/</sup>W. Smith Greig, C. L. Bedford, and Henry Larzelere, "Consumer Preferences Among Apple Varieties in Fresh and Processed Forms," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, February 1962, pp. 516-518.

be for the sauce incorporating fresh market varieties.<sup>15/</sup> However, under the existing U. S. grades, fresh market varieties such as McIntosh are apt to rank low because of their fine texture and their thin consistency.

### 3. Industry and Consumer Objectives

We have seen a difference in attitude on the part of processors and consumers as to what constitutes a good sauce or desirable variety. This difference is in part related to objectives.

Processors are interested in producing sauce of a given quality at lowest cost. Under existing technology this is most easily done with the processing varieties noted earlier. These varieties are both harder and less juicy than fresh market apples. They stand up well in the coring and peeling process. Hence less trimming is necessary and a higher yield is produced.<sup>16/</sup> In addition to these cost factors, the sauce produced from such varieties grades well.<sup>17/</sup> In some cases, however, certain varieties or types of sauce may be preferred largely because of processor or buyer prejudices.

Consumers, on the other hand, are less interested in variety and more concerned with the utility of the sauce for the end purpose they have in mind.<sup>18/</sup> Two fairly recent studies indicate that most consumers use sauce

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<sup>15/</sup>Blends involving Red Delicious are currently undergoing taste panel tests by food technologists in two States. In Pennsylvania, a three-year study by C. W. Hitz and Frank McArdle is scheduled for completion in 1965. In Virginia, Charles Wood and Bill Cooler are involved in a project that will continue through 1966.

<sup>16/</sup>According to a study of 13 New York varieties, those producing a very high yield were: Baldwin, Ben Davis, and Twenty Ounce. Varieties giving high yields included: Idared, Monroe, N. W. Greening, Rome, and R. I. Greening. On the other hand, very low yields were reported for McIntosh and Cortland. Red Delicious was not studied (R. L. La Belle, "Research Evaluates Apples for Sauce," Cornell University, Dept. of Food Science and Technology /Geneva/, January 21, 1958, p. 1. For a brief outline of these and other "processing vs. dessert qualifications," see his "Plantings of Apple Varieties in Western New York and Their Eventual Impact on Processing," February 12, 1963, pp. 1-2).

<sup>17/</sup>It will be recalled that Federal purchases (USDA and military) are made on the basis of U. S. grades. Such purchases accounted for 3.3% of the sauce pack from 1954 to 1960 (Dana G. Dalrymple, "Economic Aspects of Apple Marketing in the United States," Michigan State University, Dept. of Agricultural Economics, Ph. D. dissertation, 1962, p. 140).

<sup>18/</sup>These comments refer only to homemakers. An intermediate market -- institutional users -- will also increasingly need to be considered. An unknown but probably growing amount of sauce is served in institutional feeding establishments.



as a meat accompaniment, followed by use as a dessert, and as a cake ingredient.<sup>19/</sup> The proportion of purchasers using sauce for each of these purposes was as follows:

<u>Use</u>	<u>National</u>	<u>New York</u>
Meat accompaniment	77%	89%
Dessert	60	64
Cake ingredient	54	61

The national study indicated the following additional uses for sauce: breakfast fruit (30%); ingredient in pies (17%); topping for cakes, pastries, pancakes, waffles (9%); ingredient in sandwich filling or spreads (4%); topping for ice cream (3%).<sup>20/</sup> Unfortunately, neither survey indicated the quantity of sauce used in each of these ways.

Much of the taste panel work with sauce has essentially been in terms of a dessert item. Yet the above data suggest that a substantial amount of sauce is used as a side dish with meat or for further processing. Hence, it is quite possible that the consumer takes more than just dessert use in mind when buying sauce -- or making it in the home.

In view of this diversity of objectives it is not surprising that a difference of opinion exists on what is a good sauce, or on the role played by varieties.

#### B. Raw Product

Raw product is generally felt to be of significance in determining sauce quality and cost of processing. As we indicated in the previous section, the definition of what is good quality is a moot point, so that one must proceed cautiously in this area. Factors contributing to costs, on the other hand, are a more objective matter and, therefore, perhaps of more general meaning.

In this section we present a brief discussion of the effects of certain raw product specifications (other than variety) on sauce quality and costs. Quality was the subject of studies in Maryland and New York while factors contributing to costs were analyzed in studies in Virginia. All three

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<sup>19/</sup>A Consumer Survey on Apple Products, Owens-Illinois, Consumer and Market Research Division (Toledo), February 1959, p. 9; and Dalrymple, loc. cit. (1960, 1961). Also see L. Yvonne Clayton, Homemakers' Use of and Opinions About Selected Fruits and Fruit Products, U. S. Department of Agriculture, Statistical Reporting Service, SRS-6, May 1965, p. 7.

<sup>20/</sup>It may be of additional interest that about half of the homemakers contacted in the New York study added spices to their sauce. Most added cinnamon, while some added nutmeg. At the time of the study, of the 60 brands of sauce available in the State, only one was spiced. Furthermore, 10% of the consumers contacted in the USDA study noted above added that a good tasting sauce contained a little cinnamon (p. 11).



investigations were carried out over three-year periods during the mid to late fifties.<sup>21/</sup>

### 1. Influence on Quality

a. Maryland Study. The Maryland study noted in the previous section also considered the influence of three raw product variables on quality. These were: picking maturity, duration of storage, and storage type.<sup>22/</sup> Quality, as noted, was measured in terms of usual grade factors by an industry panel.

--Picking Maturity. It was found that the mature apples produced a sauce of higher grade -- principally because of the effect of maturity on color and texture (no effect on flavor and consistency was noted). The authors concluded, therefore, that ". . . the more mature the apple at a commercial picking level the more desirable the processed sauce, especially if processing is immediate and not after storage."

--Duration of Storage. The effect of storage on sauce quality depended on picking maturity. Those harvested at medium to late maturity declined in sauce quality with increasing duration of storage. On the other hand, apples harvested at early maturity produced a higher quality sauce after one to two months storage. In general, color improved with up to two months storage and then dropped off. The other factors also tended to improve during this period, but did not drop off as rapidly.

--Type of Storage. When apples were held in both common and refrigerated cold storage, the effect on sauce quality was about equivalent when the apples were held up to about two months.

The researchers attempted to correlate raw product tests -- presumably to include the above factors -- with sauce quality but were unsuccessful. They observed that this was probably because ". . . in sauce making the identity of the raw apple is almost completely lost in cooking, pulping, and addition of sugar and water." Even so, they felt that raw product specifications should include levels of maximum firmness and minimum solids in order to alleviate problems in texture, color, and flavor.

b. New York Study. Several of the foregoing items were investigated concurrently in New York.<sup>23/</sup> With respect to maturity, it was found

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<sup>21/</sup>It might be additionally noted that a recent Massachusetts study evaluated the effects of mechanical harvesting on the processing characteristics of Baldwins. Although there was greater peeling loss on the mechanically harvested level, the quality was felt to fall within standards (A Mechanical Harvesting and Handling System for Processing Apples, University of Massachusetts, Cooperative Extension Service, Technical Information Series, Publication No. 2, January 1965, 12 pp.).

<sup>22/</sup>Wiley and Toldby, op. cit., pp. 115-118, 122.

<sup>23/</sup>R. L. La Belle, et al., "The Relationship of Apple Maturity to Apple Sauce Quality," Food Technology, September 1960 (Vol. 14, No. 9), pp. 463-468.

that sauce color, flavor, and grain improved when fruit was allowed to tree-ripen -- especially if processed immediately following harvest. The pressure test was discarded as an index of maturity at harvest in favor of the soluble solids -- acid ratio in the fresh fruit. This was done because of the relatively greater rate of change in the solids-acid ratio prior to and at harvest.

## 2. Influence on Cost Factors

Researchers in Virginia studied the effect of size, grade and variety on two factors which influence the total cost: (1) the yield of prepared apples and (2) the trim time involved.<sup>24/</sup> The yield refers to the proportion of the original weight of apple that remains after the apples have been mechanically peeled and cored and subsequently trimmed by hand to remove remaining defects. Obviously the higher the yield, the lower the raw product cost. Trim time represents the amount of time spent in hand trimming; the less trimming required, the lower is the processing cost.

--Yield was related to the three factors noted above. It was found, as might be expected, that the larger sizes produced a higher percentage yield. Similarly, Grade 1 apples produced a higher yield than Grade 2. In the case of Yorks, these relationships were as follows in terms of percent yield of prepared apples: 64% for  $2\frac{1}{4}"$ - $2\frac{1}{2}"$  to 73% for  $2\frac{3}{4}"$  and up (in U. S. Grade 1); 61% for Grade 2 to 67% for Grade 1 ( $2\frac{1}{4}"$ - $2\frac{1}{2}"$  size). Variety was of no particular significance (the varieties tested were Grimes, York, Golden Delicious, and Stayman).<sup>25/</sup> Of the two significant factors, size appeared to have greater influence than grade.

--Trim time was also related to the above three factors. The time, again as might be expected, was proportionately less for larger apples and for higher grade apples. Yorks, for example, showed a decrease in trim time (for 100 lbs. of prepared apples) from 49 minutes for  $2\frac{1}{4}"$ - $2\frac{1}{2}"$  to 30 minutes for  $2\frac{3}{4}"$  and up (in Grade 1); similarly, trimming time decreased from 59 minutes for Grade 2 to 38 minutes for Grade 1 ( $2\frac{1}{2}"$ - $2\frac{3}{4}"$  size). The York variety required more trim time than the others. Altogether, size and grade had about equal influence on trim time.<sup>26/</sup>

In the case of yield and time, regression equations were set up to express the relationships in more precise terms. They were also used to make statistical estimates of yield and trim time.

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<sup>24/</sup>Anthony Lopez, Charles B. Wood, and Joseph M. Johnson, "Trimming Time and Yield Factors in Processing of Apple Sauce," Food Technology, January 1958 (Vol. 12, No. 1), pp. 57-64.

<sup>25/</sup>It will be noted that this selection represented dual purpose and processing varieties; fresh varieties were not included.

<sup>26/</sup>Another factor that was not explicitly included here but which was included in a subsequent study was plant equipment and policy concerning thickness of peel and size of core.

These factors were used in a subsequent study in 1956-57, when an effort was made to "develop a method of determining price differentials for processing apples of different qualities and sizes which would accurately reflect their relative values to the apple sauce processors."<sup>27/</sup> The study went on to evaluate the effect that experimental grades for apples for processing would have on grower returns from apples of different qualities.<sup>28/</sup> A full-scale test of these grades was initiated in New York State in 1964.<sup>29/</sup>

The most recent study in the Virginia series compared the trim waste from tree-run apples as opposed to those graded out from fresh packing operations. This was done because in the past processors have discriminated against table sort apples of the same grade, stating that they had higher trim waste and deteriorated more rapidly. Yet the study shows no significant difference in trim waste or deterioration when the defect level was the same on receipt at the plant.<sup>30/</sup>

All of this work is well summarized from the pricing point of view in a recent Virginia Polytechnic Institute bulletin.<sup>31/</sup>

### C. Preparation Techniques

In this section we shall consider the questions of peeling apples and adjusting product characteristics.

#### 1. Peeling

Practically all apples presently used for sauce are mechanically peeled. Several non-mechanical methods have been recently studied; and under a new system, peeling is omitted altogether.

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<sup>27/</sup>Joseph M. Johnson, Anthony Lopez, and Charles B. Wood, "Determination of Relative Value of Apples for Apple Sauce and Evaluation of Experimental Processing Apple Grades," Food Technology, October 1958 (Vol. 12, No. 10), pp. 554-561.

<sup>28/</sup>For further background and detail on this see Roy E. Moser, Jr., Grades and Values of Apples for Apple Sauce, Virginia Polytechnic Institute, Agricultural Extension Service, Circular 751, October 1957, 17 pp. The main difference between the existing and experimental grades is in the narrowing of the amount of allowable trim waste.

<sup>29/</sup>Daniel Farkas, "Apple Grading -- Testing VPI Useable Material Grades, 1964 Season," Processing Progress, Cornell University, Program in Food Processing Extension, Winter 1964, p. 4.

<sup>30/</sup>"What's in a Grade? Apples That Is!" Virginia Polytechnic Institute, News Release, February 24, 1964 (Greater detail is presented in the bulletin listed in the next fn.).

<sup>31/</sup>J. M. Johnson, Anthony Lopez, and C. B. Wood, Equitable Pricing of Apples for Processing, Virginia Polytechnic Institute, Agricultural Experiment Station, Bulletin 559, June 1965, 35 pp.



a. Peeling Methods. New peeling methods include lye treatments, a combination of chemical and steam treatments, and infrared peeling.

Lye peeling is widely used by food processors for a few fruits and most vegetables. However, peel wax interferes with the penetration of lye in lye-peeling of apples. USDA scientists have reported that wax solvents such as ethanol or isopropanol used prior to lye treatment or incorporated in the lye bath reduced the time and temperature required for lye-peeling of apples.<sup>32/</sup> Product yields were 90% or greater for alcohol-lye peeling over the temperature range used (120-180° F.).

A combination of chemical and steam peeling has been applied successfully on a commercial scale to pears and has resulted in greatly increased yields and quality of canned product.<sup>33/</sup> The pears are immersed in a solution of lye plus a wetting agent followed by a treatment with steam under pressure. The peel is removed in a specially designed washer. A similar procedure is in the developmental stage for apples.<sup>34/</sup>

Research on infrared peeling of different varieties of apples has been conducted by the Canada Department of Agriculture.<sup>35/</sup> Development of satisfactory equipment for removal of the loosened apple peels following the heat treatment still remains a problem. A commercial firm in Montreal operated an infrared peeling unit in 1964.

b. Omitting Peeling. It has generally been considered necessary to peel apples before making sauce. In the case of red apples this has been required because the anthocyanin pigment in the skin produces a brownish or pinkish sauce that does not grade well; moreover, the anthocyanin discolors in tin cans, further reducing the grade.<sup>36/</sup> Yellow apples do not face the same problem; but it is reported that unpeeled sauce is inferior in flavor, color, texture, and appearance and hence may score poorly on grade.<sup>37/</sup>

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<sup>32/</sup>W. O. Harrington and Claude H. Hills, "Lye Peeling of Apples Improved by Wax Solvents," Food Technology, March 1964 (Vol. 18, No. 3), pp. 117-118.

<sup>33/</sup>Daniel E. Callahan, "Chemical Peeling, Electronic Sorting Hikes Quality and Pear Half Yield for Calcan," Canner/Packer, February 1965 (Vol. 134, No. 2), pp. 40-42.

<sup>34/</sup>Letter from R. R. Ball, Canning Machinery Division, FMC Corporation, San Jose, California.

<sup>35/</sup>Letter from R. W. Tape, Food Research Institute, Canada Department of Agriculture, Ottawa, February 17, 1965; E. A. Asselbergs and W. P. Powrie, "The Peeling of Apples with Infrared Radiation," Food Technology, July 1956 (Vol. 10, No. 7), pp. 297-298.

<sup>36/</sup>In the U. S. grades, "good color" means that the sauce: "possesses a practically uniform, bright, typical color; is free from tinges of pink color; and is free from discoloration due to scorching, oxidation or other causes." The omission of peeling may also influence other grade factors.

<sup>37/</sup>R. M. Smock and A. M. Neubert, Apples and Apple Products, Interscience Publishers, New York, 1950, p. 302.



Recently, a patent was issued on a new process which may lessen some of these problems. The abstract of the patent reads as follows:

A continuous method of producing apple sauce from whole uncooked apples, comprising the following steps: 1/crushing the whole apples in the presence of an edible antioxidant, 2/helically conveying under centrifugal force a continuous thin layer of the crushed apples, including the edible juicy pulp and the skin, seeds and other edible solids thereof, through a narrow passageway, and 3/simultaneously centrifugally screening edible, juicy pulp from the inedible solids, to continuously extract the juicy pulp as apple sauce, and continuously discharging the inedible solids from the passageway.<sup>38/</sup>

Some sauce is reportedly being commercially prepared in this way. The product is slightly darker than a regular sauce and is packed in glass containers.

Another packer uses a somewhat different system.<sup>39/</sup> According to the manager of the firm: "The process is like the product grandma made, which wasn't peeled or cored, but cooked in a kettle with sweetener and passed through a colander." To be more specific, the apples are pulped, passed through a sweetening treatment, cooked by a unique dual-pass steam process, and then passed through a finisher which removes the calyx, seeds, and peel. Food coloring is added to one pack to give it a pink color.<sup>40/</sup>

Sauce is also being prepared in Canada from unpeeled apples.

With the elimination of the peeling and coring process, the comparative disadvantage of small apples and fresh market varieties is lessened. If the practice should spread, this point could be of considerable significance to the industry.<sup>41/</sup>

## 2. Adjusting Product Characteristics

Two of the most important characteristics of apple sauce -- flavor and consistency -- may be adjusted to some extent during processing.

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<sup>38/</sup>Patent 3,103,438, "Production of Sauces and Purees from Fruits and Vegetables," James A. Rowse, Mason, N. H., filed Nov. 13, 1961, Ser. No. 151,868. As reported in the Official Gazette, U. S. Patent Office, September 10, 1963 (Vol. 794, No. 2), p. 422 (numbering added).

<sup>39/</sup>Richard D. McCormick, "'Old Fashion' Apple Saucing Process -- No Peeling, No Coring," Canner/Packer, March 1965 (Vol. 134, No. 3), pp. 31-32.

<sup>40/</sup>When consumers were asked what color they associated with good sauce in a recent USDA survey, 15% indicated pink (Clayton, op. cit., p. 11).

<sup>41/</sup>At present, small apples are sharply discounted in price for reasons of yield and economy noted earlier; elimination of peeling and coring might lead to a narrowing of the differential paid for apples of different sizes. Varietal implications are discussed in Chapter VIII.

a. Flavor. Sauce flavor is strongly influenced by sugar content and acidity. Taste panel studies have suggested a preference for sauce with low sugar-acid ratios.<sup>42/</sup> But it has also been found that the higher the acid content of a sauce the higher the sugar content required for optimum flavor.<sup>43/</sup> The level of these two components varies with the variety and maturity of the apples.<sup>44/</sup> Sugar content may be controlled accurately by adjusting the amount of sugar added to the mix. Acidity can be regulated to some extent by blending different varieties, but there is uncertainty as to optimum degree of acidity.

Apple sauce flavor has been improved by the addition of apple essence recovered from peels and cores, a byproduct of sauce manufacture.<sup>45/</sup> The improvement in flavor diminished only slightly during storage for 10 months at room temperature. Addition of 0.1% citric acid in conjunction with essence did not produce significantly higher flavor scores.

b. Consistency. Measurement and control of consistency have been among the most difficult quality control problems for apple sauce processors. The term "consistency" generally includes two fairly independent characteristics, namely the mounding of the mass of apple sauce and the separation of liquid from the solid part of the sauce. Immature or early harvested apples have frequently been used in commercial apple sauce blends in order to obtain good consistency and profitable yields. Unfortunately, the immature apples have a relatively poor flavor and a slightly green color. Maryland investigators found that the addition of 0.5 to 0.6% of a 1-1 mixture of high and low methoxyl pectins and adjustment of sauce pH to 3.4 prior to packing reduced liquid-solids separation in apple sauce made from mature apples and improved apple sauce quality.<sup>46/</sup>

c. Storage Stability. Results of a recent study suggest that canned apple sauce should be stored at 68° F. or lower in order to minimize undesirable physical and chemical changes during storage.<sup>47/</sup>

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<sup>42/</sup>Thomas and Ritter, op. cit., p. 3.

<sup>43/</sup>E. C. Dryden and Claude H. Hills, "Consumer Preference Studies on Apple Sauce: Sugar-Acid Relationships," Food Technology, November 1957 (Vol. 11, No. 11), pp. 589-590.

<sup>44/</sup>Levels of these two items in canned sauce packed over the harvest season in Virginia are reported by Anthony Lopez, "Some Characteristics of Apple Sauce Canned in Virginia," Food Technology, January 1962 (Vol. 16, No. 1), pp. 82, 85-86.

<sup>45/</sup>M. L. Buch, et al., "Organoleptic Evaluation of Apple Sauce Fortified with Essence and Citric Acid," Food Technology, November 1956 (Vol. 10, No. 11), pp. 560-562.

<sup>46/</sup>Vernor Toldby and Robert C. Wiley, "Liquid-Solids Separation, A Problem in Processed Apple Sauce," Proceedings, American Society of Horticultural Science, 1962 (Vol. 81), pp. 78-92.

<sup>47/</sup>B. S. Luh and P. J. Kamber, "Chemical and Color Changes in Canned Apple Sauce," Food Technology, January 1963 (Vol. 17, No. 1), pp. 105-108.

D. Canned Sauce<sup>48/</sup>

Until recently, practically all of the commercially-produced sauce, be it regular pack or baby food, has been of a fine grain or finish. In 1960, a coarser grain or chunky sauce was introduced and has been gaining in importance. While most sauce has been a straight apple product, some blends have been prepared with other fruits.

In this section we shall first consider the normally finished sauce, then look at the chunky sauce, and other types of sauce. We will close with a brief review of some merchandising work.

1. Normal Finish

Changes in the production and marketing of normally finished sauce have centered about varieties and blends with other fruits.

a. Varietal Combinations. The standard apple sauce pack -- as we noted earlier in this chapter -- is usually composed of a number of varieties: some large processors use at least four. Fresh market varieties such as McIntosh are often included. On the other hand, a straight Gravenstein sauce has been produced in California for some time; it is clearly identified as such and apparently has brought a premium.<sup>49/</sup>

In the last few years several additional single variety and dual-variety sauces have been introduced. A Washington processor started packing a straight Golden Delicious sauce early in 1964, and a Massachusetts processor has been putting up a McIntosh sauce. During the 1964 season a British Columbia firm introduced a blend using Golden Delicious and McIntosh.<sup>50/</sup> All three are packed in glass.

The Washington Golden sauce was designed to compete with Gravenstein sauce. Apples used are sort-outs from fresh packing operations; the sauce grades U. S. Fancy. The first season pack was about 200,000 cases of 15-oz. glass jars. During the 1964 season a 25-oz. container was introduced. The produce is distributed over the entire West Coast and the Hawaiian Islands.<sup>51/</sup>

b. Fruit Blends. In the middle 1950's blends of apple sauce with other fruits were introduced. The number expanded gradually over the period to include combinations with cranberries, raspberries, strawberries, cherries, and pineapple.

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<sup>48/</sup>This section, unless otherwise noted, is based on contacts with industry personnel who generally prefer to remain anonymous.

<sup>49/</sup>A similar sauce is also produced in Nova Scotia (letter from A. E. Calkin, Scotian Gold Cooperative, Ltd., Kentville, Nova Scotia, March 30, 1965).

<sup>50/</sup>Letter from Ian F. Greenwood, Sun-Rype Products Ltd., Kelowna, British Columbia, November 10, 1964.

<sup>51/</sup>"New Golden Delicious Apple Sauce Introduced," The Goodfruit Grower, February 1, 1964, p. 14; Letter from James Edeler, Blue Ribbon Growers, Inc., Yakima, Washington, February 12, 1965.



At the present time the production of these items is limited to only a few processors -- and in each case is of rather minor volume. The raspberry and cranberry blends appear to have declined in popularity at retail, and the cherry blend seems to have been dropped. In two cases, where blends were added they were of chunky sauce (to be discussed in a following section).

Experience to date suggests that a substantial amount of promotion may be necessary. Even then, demand for the product is apt to vary considerably from market to market; some areas are reasonably good markets, others are not. While the retail market has been the predominant outlet, some institutional packs have been put up: one packer of the cranberry blend has found that his retail demand has dropped off almost to nothing while there has been a small but dependable demand for the institutional pack.

The blends are prepared by mixing sauce with a puree of the other fruit (the only exception being pineapple). Color is added. The blends, therefore, do not qualify under U. S. grades. This, in turn, suggests that the producer does not face the varietal and peeling limitations imposed by the grades. Whether this influences the type of raw product that is used is not clear.

The outlook among processors for the blends varies but in general is not one of great promise. One processor observes that "this type of product attracts the attention of the consuming public only briefly and then they tire of it." Another packer sees a rather static market position. We suspect that if there is to be any further growth in this area, it will probably be in the chunky blends.

## 2. Chunky

Chunky sauce is prepared in much the same way as regular sauce, but is not run through a finisher. In most cases, greater attention is given to trimming and seed cell cutting; one processor, in fact, runs his apples over his slice preparation line. The cost of the extra handling is not offset by the elimination of the finishing process, which means that it is necessary to price the product higher than regular sauce.<sup>52/</sup> Chunky sauce does not qualify under the present U. S. grades.

a. Regular. The present type of chunky sauce appears to have been first produced by a Western New York processor in 1960. Their sales increased each succeeding year depending, as the sales manager put it, "on the extent to which we could promote and advertise it." Several other firms came out with similar products during the 1964 season. Most of the packs are in 25-oz. glass jars (one firm puts up a No. 10 tin but finds the premium price to be a deterring factor).

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<sup>52/</sup>One firm in Nova Scotia discontinued making the chunky sauce four to five years ago because of the additional cost (Calkin, op. cit., November 17, 1964).



In a promotion brochure, one firm points out that the chunky nature of the sauce widens its range of usefulness -- from use as a breakfast item to baking in apple pies, dumplings, upside-down cake and others. Several pie recipes are included. The 25-oz. size is large enough to allow for these uses. Under these conditions, the chunky sauce becomes considerably more of a competitor for canned slices than is true of regular sauce (though a price differential exists).

Researchers at Virginia Polytechnic Institute have recently experimented with a similar sauce which they have called apple crush. It is specifically aimed at the dessert market. Sugar is added to bring the soluble solids content up to 28 to 38%. Equal blends of Red Delicious and Stayman were used in the initial tests. Red Delicious is not normally used in such a high proportion in sauce -- but according to the researchers proved satisfactory for this type of product.<sup>53/</sup>

b. Fruit Blends. Early in 1964, a number of blends of chunky sauce with other fruits were introduced. Two of the largest apple processors in the country are now producing blends. The process used is apparently the same as that for the normally-finished product.<sup>54/</sup> Currently, combinations with the following fruits are being offered: raspberry, strawberry, cherry, apricot, and pineapple. Both processors have followed an intensive advertising program and have promoted them as (in addition to desserts) breakfast fruits, snacks, and as toppings for cakes, puddings, and ice cream.

It is not clear at this point whether the chunky fruit blends will go the same route as the normally finished sauce blends. But in view of the amount of market testing and promotion that has gone into their preparation, they should have every chance to succeed.

c. Spiced. A chunky sauce with spice was introduced early in 1965. It is virtually the only sauce of any sort produced -- despite the fact that many homemakers add spice to sauce -- with spice added. In the promotion for this item, use with meats is emphasized.<sup>55/</sup>

### 3. Other

a. Baby Food. Apple sauce baby food is, as we indicated in Chapter II (Section D/2), a relatively important product. But little information is available on it. A glance at the baby food section of any super market, however, will reveal a wide selection of blends. Combinations are currently being made with apricots, pears, pineapple, prunes, and an orange-banana combination. Sauce is not labeled as such, but as "strained apples." Both 4 3/4-oz. and 7 1/2-oz containers are packed.

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<sup>53/</sup>Anthony Lopez and Daniel E. Carroll, "New Apple Products," Food Technology, forthcoming.

<sup>54/</sup>The comments made on raw material in the normal finish blend section (p.36) would, therefore, also appear to hold for the chunky blends.

<sup>55/</sup>See fn. 20 of this chapter for greater detail on homemaker addition of spice (p. 28).

b. Gelled. Canned gelled fruit sauces have been placed on the market and are reported to have found ready acceptance as convenience items.<sup>56/</sup> Formulas for such products, including apple sauce blends with other fruits, are based on the use of low-methoxyl pectin and a calcium salt to form the gel. Research on canned gelled apple sauce has been conducted independently by the Canada Department of Agriculture's Research Station at Summerland, British Columbia,<sup>57/</sup> by Virginia Polytechnic Institute,<sup>58/</sup> and by the U. S. Department of Agriculture's Western Regional Research Laboratory.<sup>59/</sup>

As described by the U. S. Department of Agriculture researchers, apples are peeled, cored, cut into wedges, then cooked in steam. The hot slices are immediately puréed in a pulper. Sugar (in amounts added to commercial apple sauce), low-methoxyl pectin, and citric acid are mixed in the hot sauce. A solution of calcium lactate is finally added and the hot mixture is filled into cans, sealed, and heated for five minutes in boiling water.

This treatment produces a sauce which keeps its firmness up to 120° F. The sauce can, therefore, be served on the same plate with warm foods without spreading. It could become as customary an adjunct to pork as cranberry is to turkey. The product can be melted by heating and incorporated in molds and salads. A "characteristic and pleasing tartness" can be obtained by (a) judicious blending of varieties, and/or (b) adjustment of the acidity by adding an edible organic acid, and/or (c) regulating the sugar content. The sauce can be colored red or green with a certified food color. Attractive blends may be made with other fruits.

#### 4. Merchandising Studies

Several merchandising studies on apple sauce were conducted in New York State in 1958 and 1959. They were concerned with end aisle displays (combined with price reductions and trading stamps) and multiple packaging.<sup>60/</sup>

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<sup>56/</sup>A general picture of the gelled fruit sauce market is provided in Food Manufacture, May 1962 (Vol. 37, No. 5), p. 231.

<sup>57/</sup>"New Apple Product from Progressive Laboratory," Canadian Food Industries, March 1960 (Vol. 31, No. 3), p. 60.

<sup>58/</sup>See Lopez and Carroll, op. cit. This product was discussed by the authors in "Comprehensive Progress Report on the Development of New Processed Apple Products," submitted to the Virginia State Apple Commission, 1962.

<sup>59/</sup>M. E. Lazar and A. I. Morgan, Jr., "Gelled Apple Sauce," Food Technology, March 1964 (Vol. 18, No. 3), pp. 52-53.

<sup>60/</sup>Douglas J. Dalrymple, Fruit Merchandising Experiments: Apple Sauce, Apples, Sour Cherries, Peaches, Cornell University, Dept. of Agricultural Economics, A. E. Res. 38, July 1960, pp. 9-14.

a. End Aisle Displays. When a national brand of apple sauce was displayed in end aisle positions as opposed to regular shelf locations in chain stores, sales were increased from two to three times.<sup>61/</sup>

In another test, end aisle location was combined with a price reduction of 2.2¢ per can (a change in price quotation from 2/33¢ to 7/¢1.00) and newspaper promotion. Sales were increased by over eight times.

When trading stamps (and associated promotion) were substituted for the price reduction in the end aisle display, sales were increased about twelve times in the test stores. The increase was achieved at a stamp cost of from 1.6 to 2.5¢ per can (depending on whether 30 to 50 stamps were given with each purchase of four cans).

It can be seen that the cost of the price reduction and the use of the stamps was about the same (assuming that other promotional cost was about the same). However, the stamps were associated with a bigger increase in sales than was the price reduction. Hence, in an end display the stamps appeared to be the better investment in the short run.

In each case the increase in sales was quite variable between stores and definitely was of a short term nature; movement returned almost to pre-test levels when the display was removed.

b. Multiple Packaging. Two tests were conducted to see whether the packaging of a national brand of sauce in four-packs or six-packs would increase sales. In each case a display of one of the packs was set up which also included single cans; sales were then compared with displays in other stores which were made up of single cans only. Price was comparable. To take into account a possible substitution effect, sales records were also kept of non-test brands.

In the first test it was found that sales of the branded sauce were decreased 16% when the four-pack was introduced, and increased 10% with the six-pack. In the latter case, however, the sale of other sauce brands decreased 2%. Overall, the changes in sales were probably not significant.

In a subsequent test the same packs were used, but end aisle displays were introduced. In the first phase of this test, addition of the four-pack by itself increased sales of both the test brand and other brands; the total sales increase was 9%. In the next phase, single cans were maintained on the shelf, but the four-pack was placed in an end aisle display; this resulted in an increase in sales of the branded sauce of 2.2 times (significant at the 5% level) and an overall increase of 1.5 times. At the same time, however, another test was run showing that just the addition of single cans to an end aisle display increased sales by 1.6 times.

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<sup>61/</sup>Records were not kept in this test which would indicate the effect on overall sales. As some substitution of sales would be expected, the overall increase would be less than indicated here. Yet, where overall records were kept in a subsequent study, the sales increase was still from 1.5 to 1.6 times.



It is apparent that the use of multiple packaging, in this case four- and six-packs, had no particular beneficial effect on the sale of apple sauce under a variety of situations; in fact, they showed a greater tendency to reduce, rather than increase, sales. Hence, its use from a sales point of view would appear unwarranted.

A significant sidelight of the study was that the use of end aisle displays again appeared to increase sales: this time it increased sales of the test brand 2.3 times (significant at the 5% level) and overall sales by 1.6 times.

#### E. Frozen Sauce

Although it is quite possible to freeze apple sauce, very little of this is done. In fact about the only packs at present are as a result of special institutional orders.<sup>62/</sup> Recently, however, a new frozen sauce known as "Spoonapple" was developed in Michigan.<sup>63/</sup> Browning is eliminated through a patented process for inactivating enzymes. No heat or additives are used. Flavor reportedly remains unchanged during storage.

#### F. Dehydrated Sauce

A new process has been developed for the preparation of explosion-puffed apple slices which, in turn, may be reprocessed into an instant apple sauce. The explosion-puffing process itself will be discussed in detail in the next chapter (Section F/2). We will limit our attention here to the additional steps involved in the preparation of the sauce.

Briefly, the process involves grinding up the explosion-puffed slices and adding sugar. The powder then can be instantly reconstituted by adding hot water. The resulting sauce not only has good flavor, but also has the desirable grain of that made from fresh apples (furthermore, the explosion-puffed slices may be crushed to any degree of fineness). Since the weight of the dried product is only about one-fifth that of canned sauce, it is much cheaper to ship and takes less space in storage. If protected from moisture pickup, the instant sauce will keep for an extended period under kitchen conditions.

A process for producing the sauce without cooking the apples has recently been described.<sup>64/</sup> Instead of cooking, the slices (which have been treated with sulfite, salt, and citric acid) are frozen and pulped or ground in the frozen state. A sugar mixture containing ascorbic acid and hydrocolloid stabilizer is added to the ground pulp. The apple pulp mixture is then allowed to thaw and is mixed until all the sugar is dissolved. The product is dried in a specially constructed laboratory vacuum shelf dryer equipped

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<sup>62/</sup>Based on discussion with Jerry Webster, National Association of Frozen Food Packers, February 11, 1965.

<sup>63/</sup>"Spoonapple -- Palatable Apple Sauce Needs No Cooking," Canner/Packer, September 1963 (Vol. 132, No. 9), p. 20.

<sup>64/</sup>Gestur Johnson, D. K. Johnson, and Catherine Kob, "Fresh-Flavored Instant Apple Sauce Powder," Food Technology, August 1964 (Vol. 18, No. 8), pp. 127-129.



with tabular-type infrared lamps. A fresh apple flavor was retained during both the drying process and subsequent storage at room temperature with a moisture content of 2.5% or less.

The most recent innovation has been the use of a modified atmospheric double-drum dryer.<sup>65/</sup> In the process, vapors that evolve during drying are removed rapidly from above and below the drums. A jet of chilled air is directed at the film of product on the drum just before the film reaches the doctor blade in order to solidify the product. The dry film or ribbon is pulled off the drums by means of a variable speed reel which permits control of final flake thickness. The product is collected in a dry air zone and in some cases it is finish-dried in dry air to prevent caking during storage.

Several commercial firms are understood to be experimenting with instant sauce.

#### IV. APPLE SLICES

In this chapter apple slices will be examined in the same general way that sauce was studied. Two new headings, however, will be added: dehydro-processing and fresh.

##### A. Product Evaluation

The evaluation of product quality for apple slices takes on a slightly different form than it did for sauce. While processors consider the same characteristics as for sauce -- and in fact give even more attention to them -- the situation is different with respect to marketing. This is because a much higher proportion of slices (be they canned, frozen, or dried) are both sold at the wholesale level and reprocessed than is true of sauce. That is, most of the sliced apple pack is sold in wholesale quantities to institutional feeding units and commercial bakeries. These units, in turn, reprocess the slices into baked products which are consumed on the spot or, in turn, sold to other firms for final retailing.

##### 1. Grade Standards

The U. S. Department of Agriculture, in cooperation with industry groups, has established grade standards for canned, frozen, and dried sliced apples. The canning and freezing grades give the following weight to each factor: color, 20; character (texture, firmness), 40; uniformity (wholeness, thickness), 20; and defects, 20.<sup>1/</sup> The dried grades do not have a

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<sup>65/</sup>This work will be reported in a forthcoming paper by M. E. Lazar and A. I. Morgan, Jr.

<sup>1/</sup>United States Standards for Grades of Canned Apples, effective October 17, 1953, 4 pp.; United States Standards for Grades of Frozen Apples, effective May 17, 1954, 4 pp. Both are issued by the Consumer and Marketing Service (formerly the Agricultural Marketing Service) of the U. S. Department of Agriculture.

comparable weighing system.<sup>2/</sup> Dehydrated (low moisture) grades reverse the weighing for defects and texture.<sup>3/</sup>

In a Maryland study conducted over two seasons (1955-56) an industry panel rated various types of canned slices according to color, texture (wholeness, firmness), and flavor. Of the overall variations in grade, about 45% were accounted for by color, 47.5% by texture, and 7.5% by flavor.<sup>4/</sup> On this basis, it appeared that industry preferences were relatively consistent with canning grades -- though it might be questioned whether the grades give sufficient weight to color.<sup>5/</sup>

## 2. Varietal Considerations

The same difference of opinion exists on varieties as we saw for sauce. As before, this variation exists between the industry and consumer groups.

a. Industry. The industry exhibits a definite preference for certain "processing" varieties. This is shown in both taste panels and actual practice.

Taste panels have been conducted in several States. In the Maryland study noted above, an industry panel graded canned slices made from different varieties on the basis of color, texture, and flavor. In terms of overall grade, the varieties ranked as follows, in decreasing order: York, Golden Delicious, Jonathan, Stayman, Rome Beauty, and Northwest Greening.<sup>6/</sup> When pies were evaluated by a bakery panel in a Massachusetts study, Baldwins were rated highest, followed by R. I. Greening, Northern Spy, and Cortland.<sup>7/</sup> In yet another project which evaluated varieties for freezing on the basis of frozen product quality, the most preferred varieties were: Jonathan, Yellow Newtown, Golden Delicious, and York.<sup>8/</sup>

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<sup>2/</sup>United States Standards for Grades of Dried Apples, effective October 24, 1955, 5 pp.

<sup>3/</sup>United States Standards for Grades of Dehydrated (Low Moisture) Apples, effective November 29, 1955, 7 pp.

<sup>4/</sup>Robert C. Wiley and Arthur H. Thompson, "Influence of Variety, Storage and Maturity on the Quality of Canned Apple Slices," Proceedings, American Society for Horticultural Science, 1960 (Vol. 75), pp. 61-84, especially pp. 82, 83.

<sup>5/</sup>While it might seem that the U. S. grades give undue weight to uniformity and defects in view of the Maryland study, commercial buyers are apt to be quite interested in both items.

<sup>6/</sup>Wiley and Thompson, op. cit., pp. 68, 82.

<sup>7/</sup>Letter from Kirby Hayes, Department of Food Science and Technology, University of Massachusetts, February 24, 1965. It is planned to use a broader panel in future tests.

<sup>8/</sup>Joseph S. Caldwell, Charles W. Culpepper, and Kenneth D. Demaree, "Quality of Frozen Apples Related to Variety and Ripeness," Agricultural and Food Chemistry, June 1955 (Vol. 3, No. 6), pp. 513-518.

In terms of trade practice, processors in the Appalachian region have shown a definite preference for Yorks; in fact, a clear premium is paid (ranging from 25 to 75¢/cwt., depending on the season). New York processors prefer Greenings, followed at some distance by Northern Spys and Baldwins;<sup>9/</sup> these and other preferred varieties are considered "Class A" and receive a premium over "Class B" varieties.

Because of the importance of even texture, varieties are not usually mixed. In the Massachusetts work, however, it was found that Baldwin-Greening blends, in the proportion of one to one or one to two, were nearly as acceptable as either variety alone. Blends with Cortland did not turn out as well because of a mottled appearance.<sup>10/</sup>

b. Consumer. To test consumer reaction to products baked from different varieties of apples, a series of tests were conducted with apple pies in Detroit in 1960 and 1961. Two tests were made with pies made from normally frozen slices. Varieties used in the first test were Spy, McIntosh, Red Delicious, and Jonathan; in the second test, Spys were replaced by R. I. Greening. In neither case did consumers exhibit a significant preference for a pie made from any one variety (though in each case Jonathan received the lowest score). A similar series of tests were made with pies made from dehydrofrozen slices. The results were the same.<sup>11/</sup>

### 3. Industry and Consumer Objectives

As with sauce these differences are largely related to the purposes of the individual groups.

The canner or freezer is most interested in having an apple that stands up in preparation -- even more so than he is for sauce. For while sauce is crushed once it gets by the coring, peeling, and trimming process, the slice is packaged and marketed as it is. And as the slice is ultimately reprocessed, it is considered important that it not be too mushy. Hence for reasons of economy and buyer acceptance, there is reason for preferring firmer varieties.

The definition of a consumer is, as we have seen, somewhat less clear than for sauce. However, we may think of the baker as the intermediate consumer and the housewife as the ultimate consumer. The bakery market, which will be discussed in greater detail in the next section, apparently desires a firm slice that does not turn soft before it is out of the plant. The

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<sup>9/</sup>"Apple Varieties We Like," New York State Horticultural Society Newsletter, February 1965, p. 5.

<sup>10/</sup>Hayes, op. cit., Cortland does not oxidize as rapidly as other varieties and, therefore, the slice is lighter in color.

<sup>11/</sup>W. Smith Greig, C. L. Bedford, and Henry Larzelere, "Consumer Preferences Among Apple Varieties in Fresh and Processed Forms," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, February 1962, pp. 511-513.



homemaker, on the other hand, may not have any clear preference because of the wide variety of ways she receives or utilizes slices. They may be obtained as straight slices (be they canned, frozen, or dried) or as pie mix. In addition, she may prepare some slices from fresh apples. A national survey in 1950 indicated that most of the homemakers had a favorite recipe for slices. They fell into the following categories (with associated frequency of mention): pies, 92%; cakes, 27%; salads, 21%; puddings, 16%.<sup>12/</sup> With this multitude of products and steps, it is not likely that the homemaker pays a great deal of attention to variety (except possibly to buy cooking apples when she knows that she is going to bake them).

#### 4. Institutional and Commercial Bakery Use

As we have noted, a significant quantity of apple slices are reprocessed into pies and other baked products for resale. Unfortunately, we do not have much information on the dimensions of this trade.

Michigan and U. S. Department of Agriculture studies, however, do shed some light on the use of slices in pies.<sup>13/</sup> During the late fall and early winter of 1959 and 1960, Michigan researchers surveyed institutions and commercial bakers in Detroit. Altogether, they contacted a sample of 43 institutions and 29 bakeries. The institutions included restaurants or cafeterias (91), hospitals (14), hotels (8), caterers (6), and in-plant feeding establishments (11). The U. S. Department of Agriculture study covered 88 bakeries in Washington, Baltimore, and Philadelphia in late 1960.

The type of pie stock utilized varied with the industry grouping. The institutions obtained about 47% of their slices in canned form, 25% in fresh, 18% frozen, and the rest as a combination. The bakeries followed a different pattern. In the Detroit study, the large bakeries obtained practically all (91%) of their apples as fresh slices;<sup>14/</sup> the small bakeries, on the other hand, obtained most (41%) in canned form, followed by frozen (35%) and fresh (22%). In the U. S. Department of Agriculture study, the large bakeries obtained most of their slices in frozen form (54%), followed by fresh (38%) and canned (8%); smaller bakeries tended

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<sup>12/</sup>A Consumer Survey on Apple Products, Owens-Illinois, Consumer and Market Research Division (Toledo), February 1959, p. 17.

<sup>13/</sup>W. Smith Greig and Noel W. Stuckman, Market Potentials for Dehydrofrozen and Dehydrocanned Apple Slices, Michigan State University, Dept. of Agricultural Economics, Ag. Econ. 801, September 1960, pp. 9-21; Edward J. McGrath and Howard J. Kerr, Dehydrofrozen Apple Slices: Their Potential in Selected Markets, U. S. Department of Agriculture, Economic Research Service, Marketing Research Report No. 578, January 1963, pp. 3-5.

<sup>14/</sup>It will be recalled that Detroit is in a major apple producing State and that the survey was made during a period of peak supplies (late fall and early winter). Fresh slices are discussed in greater detail in the last section of this chapter.



to lean toward canned slices while the larger ones made greater use of frozen stocks. Reasons given for bakery preference of a particular pack were: (a) canned, convenience; (b) frozen or fresh, quality. Consumer preference, significantly, was mentioned by only about 4% of those surveyed.

The Michigan study also provided some information about the marketing structure for apple pies. With respect to total production of apple pies, the commercial bakeries sold about 22% of their production to institutions, while nearly 78% went to retail outlets. The institutions, on the other hand, purchased nearly 38% of their pies and made the rest themselves. Of the total sales for final consumption, nearly 45% were made by institutions and over 55% by retail outlets.

## B. Raw Product

The effects of raw product variations on slice quality and costs were examined by the same Maryland and Virginia research groups that were noted in the previous chapter on sauce. In fact, in each case the slice studies were an almost exact parallel of the sauce studies.

### 1. Influence on Quality

In the case of the influence of raw produce on slice quality, work was done not only at the University of Maryland but also at the University of Massachusetts.<sup>15/</sup>

a. Maryland Studies. In addition to the work relating to varieties which was presented in the previous section, Maryland researchers also considered: picking maturity, effect of duration of storage, and storage type. As before, quality was evaluated by an industry-type panel<sup>16/</sup>

--Picking Maturity. If apples are to be made into slices directly after picking, it appeared that those picked at post-optimum maturity gave the highest quality ratings.<sup>17/</sup> The factors of color, wholeness, and flavor were improved with increasing maturity; firmness, of course, was not (but on the other hand, early harvested apples were too firm).<sup>18/</sup> It appears that a certain amount of sacrifice must be made in color, flavor, and wholeness if slices of proper firmness are to be obtained.

--Duration of Storage. The influence of storage depended on maturity at harvest. Slices of ideal firmness were obtained with early harvest

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<sup>15/</sup>Both dealt with more than quality (the Maryland study including numerous chemical and physical measurements), but we shall limit our discussion to this point.

<sup>16/</sup>Wiley and Thompson, op. cit., pp. 61-84, especially pp. 82, 83.

<sup>17/</sup>But they also showed the greatest trim, peel, core, and weight losses (p. 78).

<sup>18/</sup>Subsequent studies have shown that when certain processing varieties are harvested in early season, they may not yield as firm slices as those of greater maturity (from a discussion with Wiley, April 26, 1965).

apples which had ripened slightly in storage. This ripening changed the slice from a tough and rubbery product to one of more ideal firmness. Slices made from apples harvested at medium to late maturity declined in quality with increasing length of storage. When these apples were held as late as March the slices were lacking in firmness and dull in color.

--Type of Storage. Apples kept in common storage did not produce as high quality a slice as those in refrigerated storage. The effects were about equal when the apples were held in common storage about half as long as in refrigerated storage.

In another phase of the study, an attempt was made to correlate certain chemical or physical raw product factors with canned slice quality. No one factor did a satisfactory job of measurement, but those that appeared to be most important included: titratable acidity, shear-press, soluble solids and sugar-acid ratio. Combining these factors into one equation did a more satisfactory job. Varieties that responded most satisfactorily to this system were Golden Delicious, Rome Beauty, and Stayman.

A subsequent study revealed that softening of apples of varying maturity and ripeness, both on the tree and in storage, was due to a change in the proportion of AIS components (alcohol-insoluble solids; principally starches, pectinic acids, hemi-celluloses and cellulose) as well as to a decrease in the total AIS.<sup>19/</sup> Firm apples contained a greater proportion of starch and a smaller proportion of cellulose than "soft" types. Starch appeared to be the most important component associated with softening on a fresh-weight basis, while starches and cellulose were the most important on an AIS percentage basis. Determination of starch content on a fresh-weight and an AIS percentage basis could be used to indicate degree of firmness.

b. Massachusetts Study. Firmness of raw product was evaluated in terms of pie quality in Massachusetts. It was found that the minimum desirable pressure test levels for a number of varieties were as follows: apples to be frozen, 15 to 17 pounds; apples to be used for fresh slices, 15 pounds. Below these limits, "loss of character or texture occurs, with distinct mushiness appearing in both frozen slices and pies."<sup>20/</sup>

## 2. Influence on Cost Factors

As they did with sauce, Virginia researchers studied the effects of size, grade, and variety on two factors which affect total cost: (1) the yield of prepared sliced apples and (2) trim time involved.<sup>21/</sup>

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<sup>19/</sup>Robert C. Wiley and G. E. Stenbridge, "Factors Influencing Apple Texture," Proceedings, American Society of Horticultural Science, 1961 (Vol. 77), pp. 60-72.

<sup>20/</sup>Hayes, op. cit.

<sup>21/</sup>Anthony Lopez, Charles B. Wood, and Joseph M. Johnson, "Trimming Time and Yield Factors in Processing of Apple Slices," Food Technology, March 1959 (Vol. 13, No. 3), pp. 186-192.

--With respect to yield, it was found that size and grade had a significant influence, but that the varieties tested (York, Golden Delicious, Grimes Golden, Stayman, and Jonathan) did not.<sup>22/</sup> The larger sizes of all varieties produced a greater percentage of prepared product than the smaller sizes. Similarly, Grade 1 apples yielded a higher percentage of product than Grade 2. For Yorks the percent of prepared slices changed as follows: 57% for  $2\frac{1}{4}$ "- $2\frac{1}{2}$ " apples to 63% for  $2\frac{3}{4}$ " and up apples (Grade 1); 55% for Grade 2 to 61% for Grade 1 ( $2\frac{1}{2}$ "- $2\frac{3}{4}$ " size). Size proved to be a more important factor than grade in influencing yield.

--Trim time was significantly related to size and grade -- decreasing as size increased or as grade improved. For instance, in the case of Yorks the amount of trim time per 100 pounds of prepared slices changed as follows: from 57 minutes for  $2\frac{1}{4}$ "- $2\frac{1}{2}$ " apples to 32 minutes for  $2\frac{3}{4}$ " apples (Grade 1); and from 68 minutes for Grade 2 to 43 minutes for Grade 1 ( $2\frac{1}{2}$ "- $2\frac{3}{4}$ " size). All told, size and grade had about the same effect on trim time.

In the case of both yield and trim time, equations were set up to express the relationships in more precise terms. Estimating equations were also set up for assessing the effects of size and quality on the costs of peeling and trimming.

This work was subsequently expanded, as in the case of sauce to more closely examine the relationship between size and quality and value of apples for processing.<sup>23/</sup> Experimental grades, which would more fully take these differences into account, were also tested.<sup>24/</sup>

The most recent Virginia study, as noted in the sauce chapter, concerns the trim waste involved with using tree-run apples as opposed to those sorted out from a fresh grading operation. Where the apples were of the same grade, there appeared to be no difference. This and the other slice grade work is well summarized in a recent Virginia Polytechnic Institute bulletin.<sup>25/</sup>

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<sup>22/</sup>Except for Jonathan, the varieties tested were dual purpose or processing types.

<sup>23/</sup>Joseph M. Johnson, et al., "Relationships of Apple Grade and Size to Apple Value in Processing of Apple Slices," Food Technology, July 1959, (Vol. 13, No. 7), pp. 385-390. Supplementary information is provided by Johnson and Lopez in a mimeograph titled "Application of Equations for Determining Several Factors in Apple Processing," (14 pp.).

<sup>24/</sup>They were the same grades as reported in the sauce section. The study went on to suggest size classification on the basis of the number of apples per 100 pounds of fresh fruit.

<sup>25/</sup>J. M. Johnson, Anthony Lopez, and C. B. Wood, Equitable Pricing of Apples for Processing, Virginia Polytechnic Institute, Agricultural Experiment Station, Bulletin 559, June 1965, 35 pp.



## C. Preparation Techniques

The peeling techniques which were discussed in the previous chapter for sauce are equally applicable for slices and will not be discussed here. Rather, we shall focus our attention on the use of calcium salts, blanching methods, and vacuum treatments.

### 1. Use of Calcium Treatments

The use of calcium salts makes possible the processing of apples normally considered unsuitable because of variety, advanced maturity, or natural texture losses during processing. Also, the processing period during which a given variety can be packed at a high quality level can be extended by calcium firming. The use of these treatments has been studied by a number of researchers.

Two studies conducted in the 1950's are of initial interest. In 1950, U. S. Department of Agriculture investigators reported on a two-year test which compared pies made with summer varieties treated with calcium chloride with pies made from fall or winter varieties.<sup>26/</sup> In terms of flavor, the calcium treated summer varieties (Yellow Transparent, Williams, Rambo, Gravenstein) were equal or superior to the fall and winter varieties. The calcium chloride did not affect the flavor. A subsequent study indicated that while calcium chloride treatments provided some benefits on moderately soft fruit, they did not correct a soft, mushy texture resulting from definite overripeness.<sup>27/</sup>

A more recent report discussed results of using calcium lactate instead of calcium chloride in canning and freezing.<sup>28/</sup> The tests suggested that texture and maturity can be significantly firmed by the addition of calcium lactate. The latter compound was considered preferable to calcium chloride because it appeared to penetrate apple slices more readily than other calcium salts and does not have the salt flavor of calcium chloride.

A comprehensive study of the influence of added calcium salts on the texture of processed apples was more recently reported in a Maryland bulletin.<sup>29/</sup> Calcium-treated slices of two varieties were evaluated objectively (using a shear press) and subjectively (by a two-member panel). Addition of

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<sup>26/</sup>Margaret H. Stirton and Claude H. Hills, "Flavor of Summer, Fall, and Winter Varieties of Apples Baked in Pies," Food Technology, August 1950, (Vol. IV, No. 8), pp. 327-329.

<sup>27/</sup>Caldwell, op. cit.

<sup>28/</sup>Roland W. Archer, "Firming Processed Apples with Calcium," Canner/Packer, September 1962 (Vol. 131, No. 9), pp. 28-29.

<sup>29/</sup>J. L. Collins and Robert C. Wiley, Influence of Added Calcium Salts on Texture of Thermal-Processed Apple Slices, University of Maryland, Agricultural Experiment Station, Bulletin A-130, December 1963, 62 pp., especially pp. 53, 54.

calcium to slices during the canning process resulted in better retention of raw-slice firmness as compared with controls. Calcium lactate was found to be more efficient as a firming agent than calcium gluconate. An increased efficiency of calcium was shown with increasing length of storage of apples. Results of a baking study indicated that calcium-treated slices were more resistant to heat breakdown than untreated slices; the degree of sloughing and wholeness, however, did not appear to be affected to the same degree.

## 2. Blanching

Recent developments in blanching concern the use of infrared radiation and temperature.

In an attempt to reduce loss of flavor and general quality of apple slices caused by conventional blanching methods, Canadian researchers compared the effects of infrared heating with those of steam- and vacuum-blanching on several varieties of apples.<sup>30/</sup> When the slices were subsequently frozen and examined organoleptically after six months storage at 0° F. the infrared-blanching slices retained the best texture, flavor, and color. However, the canning of infrared-blanching slices were complicated by the fact that air in the tissues is not removed during blanching.

New York investigators have reported that canned apple slice firmness was significantly affected by steam-blanch temperatures in processing as well as by maturity.<sup>31/</sup> An interrelationship was found between the ratio of alcohol-insoluble solids (AIS) to total solids (TS) in the raw fruit, steam-blanch temperature, and maturity at harvest. Greater canned slice firmness was associated with a higher AIS-TS ratio. Firmness generally increased at higher steam-blanch temperatures in the range of 212° to 244° F. With a low AIS-TS ratio, canned slice firmness first increased with higher steam-blanch temperatures, then decreased.

## 3. Vacuum Treatments

A continuous, automatically controlled vacuum treatment unit to replace batch vacuum processing in the canning of solid-pack apples has been developed on a pilot plant scale in British Columbia.<sup>32/</sup> The unit consists essentially of a vacuum chamber mounted above two water-filled "legs" 32 feet in height which form vacuum seals. Peeled apple sectors

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<sup>30/</sup>E. A. Asselbergs, W. P. Mohr, and J. G. Kemp, "Studies on the Application of Infrared in Food Processing," Food Technology, September 1960 (Vol. 14, No. 9), pp. 449-453.

<sup>31/</sup>R. S. Shallenberger, et al., "Firmness of Canned Apple Slices as Affected by Maturity and Steam-Blanch Temperature," Food Technology, January 1963, (Vol. 17, No. 1), pp. 102-104.

<sup>32/</sup>J. A. Kitson, "Continuous Vacuum Unit Simplifies Apple Process," Food Engineering, September 1961 (Vol. 33, No. 9), pp. 94-95.

or slices are conveyed up the incoming leg, then through the vacuum chamber on a mesh conveyor belt, and finally discharged through the outgoing leg. The slices are blanched in a continuous hot water blancher and canned. The produce processed by this method was shown to have a firmer texture than that produced by the batch vacuum process.

In another study, a comparison was made of dry solids content of canned apple slices as affected by processing treatment.<sup>33/</sup> The investigation showed that as much as 30% of the original dry matter content may be lost through leaching if the soak method (12 hour immersion in sodium-chloride brine) is used to remove oxygen, but the loss is less than 10% if the slices are de-aerated by the vacuum-steam release method.

#### D. Canned Slices

As processing methods for canned slices were discussed in the previous section, we will turn our attention here to marketing considerations.

Most of the canned slice pack -- as we noted in Chapter II -- is sold to the wholesale market, while a smaller portion goes to the retail market. In 1963, approximately 75% of the pack was put up in institutional-size units (No. 10 cans) and 25% in consumer-size containers.

Canned slices are of two main forms: (1) regular slices, and (2) pie filling.<sup>34/</sup> During the 1963 season about 87% of the total pack was made up of regular slices, while about 13% represented pie filling.<sup>35/</sup> When the total pack was divided into wholesale and retail units, however, the situation was somewhat different: the pie mix represented only about 2% of the wholesale pack, but nearly 49% of the consumer pack. In other words, the retail pack was nearly divided between regular slices and pie filling.

Slices are also marketed at retail as spiced rings. Generally the rings are packed in glass and have red color added (green is used to a limited extent). No data exist on the total pack of this item, but estimates by several processors would place it as about equal to pie filling.<sup>36/</sup> Use as a meat accompaniment is suggested on some labels. Sales appear to be on the increase.

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<sup>33/</sup>G. W. Hope, "Loss of Solids During the Canning of Apple Slices," Food Technology, February 1965 (Vol. 19, No. 2), pp. 109-110.

<sup>34/</sup>The pie filling is made in much the same way as regular canned slices but contains added starch and acid (often corn starch and citric acid). Recently a filling containing cinnamon and raisins was introduced.

<sup>35/</sup>Computed from data presented in: Canned Food Statistics, 1963, pp. 68-69, and "Pack of Canned Fruit and Berry Pie Filling," National Cannery Association, July 1964. The pie pack totaled nearly 496,000 cases (2 1/2).

<sup>36/</sup>That is, about 500,000 cases. Some processors do not include spiced rings in their sliced pack reports; others probably do.



Diced apple chunks ("cubets") are being packed in Oregon for use as a desert item in salads (e.g., Waldorf or jellied). Red Delicious apples are reportedly used. Washington processors are also interested in the product.

#### E. Frozen Slices

Very few changes have taken place in the production and marketing of regularly frozen slices. Practically all of the pack is put up in 30 lb. tins and sold to wholesale buyers for reprocessing. Several packers of frozen slices have made improvements in their processing techniques, but knowledge of these innovations is not in the public realm.

Many apple pies are, of course, retailed in frozen form. Recently, a new product known as apple "crisps" has been introduced in Canada.<sup>37/</sup> "Crisps" are prepared by filling foil dishes with frozen or preheated slices and adding either dry sugar, thickener or spices, or a thickened syrup. The mix is covered with a topping consisting of brown sugar, flour, and butter. The package is then sealed and frozen. It is prepared for serving by heating in an oven. A similar type of product is being marketed commercially as escalloped apples.

#### F. Dehydrated Slices

The principal dehydrated apple products are (1) dried apples, and (2) low-moisture apples. Low-moisture apples are obtained by redrying the apples in low humidity air at moderate temperature or in vacuum drying equipment. According to United States standards, the dried apples (which have been treated with sulfur dioxide) contain not more than 24% moisture, while the low-moisture apples contain 2.5 to 3.5%, depending on grade.<sup>38/</sup> Most of the recent work with dehydration has been done at the Eastern and Western Regional Research Laboratories of the U. S. Department of Agriculture.<sup>39/</sup>

##### 1. Dry-Blanch-Dry

A new method of producing non-sulfured dehydrated apples has been developed at the Western Regional Research Laboratory.<sup>40/</sup> It has been named the dry-

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<sup>37/</sup>Dorothy Britton and J. A. Kitson, "Frozen Fruit Crisps," Food Research Notes, Canada Department of Agriculture, Food Research Information Office (Ottawa), July 1964, p. 4.

<sup>38/</sup>United States Standards for Grades of Dried Apples and United States Standards for Grades of Dehydrated (Low-Moisture) Apples, op. cit.

<sup>39/</sup>The reader may also wish to see Harold R. Bolin and Fred S. Nury, "Some Factors Affecting Apple Dehydration," Proceedings, Fifth Annual Research Conference, Dried Fruit Industry Research Advisory Committee, June 15, 1964, pp. 9-11.

<sup>40/</sup>M. E. Lazar, E. J. Barta, and G. S. Smith, "Dry-Blanch-Dry (DBD) Method for Drying Fruit," Food Technology, September 1963 (Vol. 17, No. 9), pp. 120-122.

blanch-dry method after the sequence of processing operations which consist of a partial dehydration followed by steam blanching and completion of drying to the desired moisture level. A dip containing citric acid and salt is used to prevent surface darkening of the apple slices during the initial drying to 50% weight reduction. Blanching prevents subsequent enzymatic darkening of the product. However, blanching the fruit in its undried state usually collapses the tissue and results in an inferior product; these undesirable effects are minimized by delaying blanching until the initial drying step is completed.

Diced apples ( $\frac{1}{2}$ -inch cubes) dehydrated to 3.3% moisture by the DBD method retained their initial high quality during storage for one year at 70° F. Reconstitution characteristics were excellent.

## 2. Explosion Puffing

Another method of dehydrating apples -- explosion puffing -- has been developed at the Eastern Regional Research Laboratory. The process consists of partially dehydrating fruit or vegetable pieces by conventional means, heating these pieces in a closed vessel or "gun" until the water contained within the pieces becomes superheated, then instantly discharging the intact pieces from the gun through a quick-opening lid.<sup>41/</sup> The flashing of water vapor from within the pieces creates a porous structure that permits both a more rapid final dehydration and a much more rapid rehydration. The porous structure remains intact during the final dehydration in which a moisture content sufficiently low to insure good storage stability is attained.

The puffing gun consists essentially of a stainless steel cylinder 10 inches in diameter and 30 inches long. One end of the cylinder is closed and the other has a hinged lid fitted with a special lock for closure as well as for instant release. The cylinder is motor driven to rotate on its long axis and has two external gas burners for heating. The gun is similar in type to that used in puffing cereals but explosive puffing does not create a large increase in volume as in the case of the familiar puffed wheat or rice breakfast cereals.<sup>42/</sup>

In the explosive puffing process as applied to apples, mature sound fruit is mechanically peeled, cored, and sliced (12's).<sup>43/</sup> The slices are dipped

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<sup>41/</sup>J. Cording, Jr., R. K. Eskew, and J. F. Sullivan, "Quick-Cooking Dehydrated Vegetables," Food Engineering, June 1963 (Vol. 35, No. 6), pp. 52-55.

<sup>42/</sup>Further details of construction and operation are provided by W. K. Heiland and R. K. Eskew in A New Gun for Explosive Puffing of Fruits and Vegetables, U. S. Department of Agriculture, Agricultural Research Service, Eastern Utilization Division (Philadelphia), ARS 73-47, April 1965, 7 pp.

<sup>43/</sup>N. H. Eisenhardt, R. K. Eskew, and J. Cording, Jr., "Explosive Puffing Applied to Apples and Blueberries," Food Engineering, June 1964 (Vol. 36, No. 6), pp. 53-55.

in a sulfite solution to control color during subsequent processing and storage. Partial dehydration is conducted in a hot-air dryer until a moisture content between 20 and 30% is reached. The remaining moisture is equilibrated among the pieces for a number of hours in order to insure a uniform puffing action. A 15-pound charge of the partially dehydrated slices is then placed in the preheated gun. Temperature and pressure are brought to the desired conditions by external heating and introduction of superheated steam while the gun is being rotated. The material is discharged after several minutes treatment and 9 to 10 charges can be puffed per hour.

After discharging from the gun, the puffed apple slices are dried to a final moisture content of about 2% in a tray or belt dryer. This step requires about five hours as compared with about 12-1/2 hours for unpuffed slices of the same moisture content.

Conventionally dried apple slices require a minimum five-hour soaking before use. Slices which have been explosion-puffed are ready for use in pies after boiling for only five minutes.

### 3. Osmotic Drying

Another method of dehydration, termed osmotic drying, is in the laboratory stage of development.<sup>44/</sup> Apple slices are mixed with an equal weight of sucrose and stored overnight at room temperature, or for about two hours at 120° F. This treatment reduces the fruit to about 50% of its original weight and the sugar becomes a heavy syrup -- having drawn the juice from the fruit by osmosis. After separating the fruit from a syrup, the fruit can then be dried in hot air to the desired moisture content of 3 to 4%. The dried product is reported to have good color and flavor.

It appears that removing about half the water by osmosis "sets" the structure so that the remaining water can be easily removed to a low moisture content. The product evidently does not shrivel and shrink as much as the fresh item dried by conventional means and the fruits should have better rehydration characteristics than conventionally dried items. Whether or not the new process will be commercially feasible remains to be seen.

### 4. Marketing

Dried apples are usually prepared both as regular slices, rings, or chops. The slices are more apt to be used for retail packs and for baking; rings are exported. The chops, which are usually made from unpeeled and uncored apples, are used in the preparation of the cake mixes, cookies, and mincemeat; explosion-puffed chops can be used as an ingredient in

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<sup>44/</sup>Information supplied by Glen Watters, Fruit Processing Investigations, Fruit Laboratory, Western Regional Research Laboratory, U. S. Department of Agriculture, Albany, California, March 1965.



dry cereals or made into a compote. A dehydrated snack product known as "Snapples" is currently undergoing market tests on the West Coast.<sup>45/</sup>

#### G. Dehydroprocessed Slices

The principal forms of dehydroprocessing are dehydrocanning and dehydro-freezing. Both techniques were developed at the Western Regional Research Laboratory of the U. S. Department of Agriculture.

##### 1. Dehydrocanning.<sup>46/</sup>

This process consists basically of a partial dehydration of apple slices followed by canning. The chief advantages are economies in packing, transportation, and storage.

In preparation, the apple slices are first dipped in a solution of salt and citric acid to prevent surface browning, then dried to half of their original weight. Drying is done in conventional equipment and is followed by blanching in steam. Cans are filled and packed tightly, sealed hot, processed for five minutes in boiling water, and finally water cooled. Storage stability of the product is good through one year at 70° F., but browning occurs and the product becomes unacceptable when stored at 90° F. for six months.

So far as is known, dehydrocanned apples are not yet in commercial production, but trial packs have been made in each of two plants. In these trial packs, the product was packed in No. 10 cans. This size can, however, was found to be too large in diameter to allow rapid cooling after cooking. As a result, the slices were excessively softened and did not rehydrate quite as readily as those prepared under more favorable conditions. Consequently, reconstitution and yield problems were encountered by bakers in a market test using product from the above-mentioned commercial trial packs.<sup>47/</sup>

Dehydrocanned apples were subsequently produced in the pilot plant at the Western Regional Research Laboratory under more carefully controlled conditions and packed in No. 2 cans. Each can contained a generous amount of material for preparing a 9-inch pie. The slices rehydrated fully when baked and the pies were found to be of high quality.

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<sup>45/</sup>In making "Snapples," dried apple slices are deep-fried with cinnamon and sugar and packaged in foil bags ("Fruit-O-Scope," American Fruit Grower, January 1965, p. 39).

<sup>46/</sup>This section is based on M. J. Powers, et al., "Dehydrocanned Apples," Food Technology, August 1958 (Vol. 12, No. 8), pp. 417-419, and information supplied by D. G. Guadagni of the Western Regional Research Laboratory.

<sup>47/</sup>Greig and Stuckman, op. cit., pp. 39-51. Bakers, it should be noted, were also unfamiliar with the use of a dehydrocanned product.

The researchers believe, therefore, that dehydrocanned apples have a future and that successful introduction of the product will involve: (a) development of adequate process control procedures for commercial production, and (b) use of slim cans (with diameter appreciably less than No. 10 size).

## 2. Dehydrofreezing

This process consists essentially of a partial dehydration of apple slices followed by freezing. The product is stored and distributed in the frozen form.

a. Characteristics and Technology.<sup>48/</sup> In dehydrofreezing, as in dehydrocanning, advantage is taken of the fact that changes in quality which occur during the early stages of drying are negligible. Consequently, little or none of the fresh apple flavor is lost in dehydrofrozen apple slices and the fresh flavor characteristics are retained for a year or longer in storage at 0° F.

Dehydrofrozen slices have a number of advantages over conventionally frozen slices. These include reductions of about 50% in freezing, storing, transportation, and container costs. Only about half the refrigerated space is needed. Furthermore, the thawed slices lose little or no juice even after complete thawing because of their partially dried condition. By using dehydrofrozen apples, therefore, the baker can readily control the moisture content of his pies.

Apples to be dehydrofrozen are selected, harvested, handled, and stored with the same care as when used for freezing or canning. The fruit is peeled, cored, and sliced in the usual manner. The apple slices are then dipped in a solution of sulfur dioxide to prevent discoloration, drained, held for a period to obtain penetration of sulfur dioxide (to prevent subsequent discoloration), and dried to half their original weight in an air dryer. The drying time required, using a through-flow type of continuous belt dryer, is very short (1/2 to 1 hour) and the product is frozen immediately after drying. Dehydrofrozen slices may be blanched before freezing -- making for easier filling of containers. Blanching also eliminates the tendency toward center discoloration during defrosting of slices in which sulfur dioxide penetration has not been adequate.

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<sup>48/</sup>The basic references for this section were: W. F. Talburt, L. H. Walker, and M. J. Powers, "Dehydrofrozen Apples," Food Technology, December 1950 (Vol. 4, No. 12), pp. 496-498; L. H. Walker, M. J. Powers, and D. H. Taylor, "Factors in Processing Methods which Affect the Quality of Dehydrofrozen Apple Slices," Food Technology, November 1955 (Vol. 9, No. 11), pp. 576-582; M. E. Lazar, E. O. Chapin, and G. S. Smith, "Dehydrofrozen Apples: Recent Developments in Processing Methods," Food Technology, January 1961 (Vol. 15, No. 1), pp. 32-36. Information was also supplied by G. S. Smith and D. G. Guadagni of the Western Regional Research Laboratory.

Detailed directions for the use of dehydrofrozen slices in different types of pies by commercial bakers have been given in a recent trade publication.<sup>49/</sup>

b. Market Tests. Market tests with dehydrofrozen apples were conducted by both the U. S. Department of Agriculture (USDA) and Michigan State University in late 1960 and early 1961.<sup>50/</sup> In each case, dehydrofrozen slices were provided bakeries and institutional users for a test period.

The firms were then interviewed for their reactions. The most frequently cited advantages in the USDA study were: convenience (54% of respondents),<sup>51/</sup> quality (31%), and versatility (7%). At the same time, the most frequently mentioned disadvantages were: additional preparation time and labor (49%), size of slices (14%), reconstitution difficulties (11%), and lack of versatility (11%). Similarly, in the Michigan study, the additional time and labor required for reconstitution was cited as a principal disadvantage.<sup>52/</sup>

One of the major findings of the USDA study was that larger firms were more apt to be favorably disposed toward the dehydrofrozen slices than were the smaller firms. The authors noted that "the product apparently will fit best into the operations of these large users where the obvious economies of handling and distribution are a definite and substantial saving." At the time of the survey, most of these larger firms purchased their slices in frozen and fresh form.<sup>53/</sup>

The Michigan study indicated that users of frozen slices were most favorably inclined toward the dehydrofrozen slices. Both frozen and canned users ranked the dehydrofrozen slices high in quality, but the frozen users rated dehydrofrozen highest in acceptability. That is, one-third

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<sup>49/</sup>D. G. Guadagni and Jean Harris, "Dehydrofrozen Apples for the Baker's Use," Bakers Weekly, July 31, 1961 (Vol. 191, No. 5), pp. 32-34.

<sup>50/</sup>Greig and Stuckman, op. cit., pp. 21-38; McGrath and Kerr, op. cit., pp. 5-19. The Michigan study was conducted in Detroit and the U. S. Department of Agriculture study in Washington, Baltimore, and Philadelphia.

<sup>51/</sup>This was traced to the facts that (1) the dehydrofrozen container was easier to dispose of than the usual containers, and (2) the dehydrofrozen pack took only about half as much space.

<sup>52/</sup>Somewhat different answers might have been obtained if the product had not been so new to many of the respondents.

<sup>53/</sup>Yet when firms were asked whether they would be willing to pay the same price for dehydrofrozen as they were now paying for their present slices (canned, 14.6¢; frozen, 16.5¢; and fresh, 15.5¢), the highest proportion of yes answers was obtained from users of canned slices and the lowest from users of frozen slices. Furthermore, those using canned slices were most apt to note favorable characteristics in the pies baked with dehydrofrozen slices. (The differences, however, may not have been significantly different).



of the frozen users could be considered an immediate market for dehydro-frozen at a less than 15% price differential under frozen; the other two-thirds could be considered a potential market. Both canned and fresh users rated lower as markets and the fresh users were least interested in the dehydrofrozen product. A concurrent Michigan State taste panel study indicated that pies made from dehydrofrozen slices were considered equal or superior to pies made from normally frozen slices.<sup>54/</sup>

c. Present Situation. There are at present a number of producers of dehydrofrozen apples, particularly in the area centering around New York State. One estimate suggests that half the apples frozen in New York are dehydrofrozen. Although a substantial processor investment is required, the production of dehydrofrozen apples offers cost advantages over canned or frozen apples.<sup>55/</sup> Some freezers, however, have indicated a reluctance to go into dehydrofreezing because of the limited number of large buyers at present.

Buyer evaluation of the outlook for the product varies, ranging from optimism to skepticism. On one hand, there is one group, including large users, that is quite enthusiastic about the product. One large chain store, for instance, has been reported using dehydrofrozen slices in all its pies. Advantages, compared with regularly frozen slices, were cited as follows: (1) raw product -- easier to use, more economical, keeps longer after use; (2) pies -- better flavor, better texture, better keeping qualities.<sup>56/</sup> On the other hand, there is a less enthusiastic group which cites (1) the extra step of reconstitution, and (2) a feeling that dehydrofrozen slices do not make as good a frozen pie.<sup>57/</sup>

It is believed that many bakers are reluctant to change pie-baking practices with which they have become accustomed. Hence, further educational and promotional efforts will undoubtedly be needed to acquaint potential customers with the advantages of using dehydrofrozen apples.

#### H. Fresh Slices

Earlier in this chapter it was indicated that bakeries and institutions obtained a significant portion of their slices in fresh form. By this, we mean that they purchased fresh slices that had been treated with sulfur

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<sup>54/</sup>W. Smith Greig, Mary E. Grant, and Henry E. Larzelere, "The Effect of Methods of Freezing Apple Slices on Consumer Preference for Pies," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, May 1960, pp. 929-935.

<sup>55/</sup>Vern F. Kaufman, "Costs and Methods for Pie-Stock Apples," Food Engineering, December 1951 (Vol. 23, No. 12), pp. 97-105.

<sup>56/</sup>Martin Eisenstaedt, "Pie of the Future from Dehydrofrozen Apples," Food Processing, March 1958 (Vol. 19, No. 3), pp. 65-66.

<sup>57/</sup>Experimental trials conducted at the Western Regional Laboratory, however, indicate that excellent frozen pies can be made from the dehydro-frozen slices.

dioxide ( $\text{SO}_2$ ) to prevent browning,<sup>58/</sup> packed in plastic bags, and held in refrigerated storage. In addition, some commercial users purchase whole fresh apples, and then prepare their own slices.

Unfortunately, there is little information available on the extent and nature of the fresh slice industry. Contact with a few members suggests that it is not easily defined: there are all kinds and sizes of operations, and considerable mobility in and out. Most fresh slicers, however, apparently make heavy use of sorts from fresh grading operations -- and hence tend to be found near producing areas and are seasonal in nature.<sup>59/</sup> Coring and peeling operations are carried on in the normal fashion, but apparently less attention is paid to removing the seed cells.

Because sulfur dioxide tends to impart an unpleasant taste, and at high concentrations to decrease crispness, some attention has been given to finding a new treatment. Recently the Western Regional Research Laboratory of the U. S. Department of Agriculture experimented with a new process involving a 45-second dip in a bisulfite solution ( $0.25\% \text{NaHSO}_3$ )<sup>60/</sup> followed by a five-minute soak in an alkaline buffer ( $0.20\% \text{K}_2\text{HPO}_4$ ). The pre-dip in the bisulfite solution retards oxidation that might take place before the buffer has a chance to work. Following treatment the apples were held in polyethylene bags at  $34^\circ \text{F}$ . until analyzed for color and crispness. It was found that the apples treated in this manner had a much better flavor and maintained their color and texture at least three times as long as those produced by present processes.

## V. RELATED APPLE PRODUCTS

There are a number of apple products on the market which are similar to sauce and slices. They include apple butter, baked apples, and spiced crabapples. In some cases, these items may be included in the economic statistics which were discussed in Chapter II. We will, therefore, review them very briefly here.

### A. Apple Butter

Apple butter is a sweet sauce-like product that is often used in much the same way as a jam or apple sauce (when sauce is used as a meat accompaniment).

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<sup>58/</sup>Although sodium bisulfite ( $\text{NaHSO}_3$ ) dips are reported to be used only on apples to be frozen or dehydrated, the authors have seen fresh slices which have apparently received this treatment.

<sup>59/</sup>There are, however, curious exceptions. Most of the slices used in the Washington area, which is near the Appalachian fruit belt, appear to come from New York City.

<sup>60/</sup>H. R. Bolin, F. S. Nury, and B. J. Finkle, "An Improved Process for Preservation of Fresh Peeled Apples," The Bakers Digest, June 1964 (Vol. 38, No. 3), pp. 46-48.



According to law it must be composed of five parts of apples to (a) two parts of sugar or (b) two and one-half parts of cider, as well as seasoning. Butter may be made from any form of apple (fresh, frozen, canned, or dried) and the skins, seeds, and pits are to be screened out. Soluble solids are not to be less than 43%.<sup>1/</sup>

The Federal grades for apple butter include the same five factors used for sauce: color, consistency, finish, defects, and flavor. The definition of these characteristics, or course, is different.<sup>2/</sup>

Separate economic statistics do not exist on butter, but one leading processor estimates that perhaps the equivalent of 500,000 bushels of apples are used for this purpose, and that about 1.5 million cases (28 oz. equivalent) are produced.<sup>3/</sup>

## B. Baked Apples

Baked apples are of two main types: (1) unpeeled whole and (2) peeled quarters. The whole apples are packed two, three, or four to a can. The quarters are labeled "Dutch Baked." Spice is usually added.

The intended use of each product varies somewhat. The labels of one leading packer suggest that the whole apples are "Ideal for breakfast, served warm with cream or milk; for lunch or parties, cold with whipped cream dusted with cinnamon; for dinner, as a tasty garnish to roast meat or fowl." It is suggested that the quarters may be served "warm or cold with cream, milk, or whipped cream," used "in cobblers, dumplings, deep dish apple pie, or chopped in a blender" to make a spicy-tart apple sauce side dish or dessert.

The principal problem in canning whole apples is the removal of gas from the apple tissue. If this gas is not removed it will accumulate in the headspace after canning and cause can corrosion and product discoloration. Research workers in British Columbia have recently described a procedure for solving this problem.<sup>4/</sup>

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<sup>1/</sup>Unlike other apple products, apple butter falls under Federal standards of identity. These are presented in detail in the Code of Federal Regulations, Title 21-Food and Drugs (revised as of January 1964), Chapter 1, Subchapter B, Part 29, Section 29.1 (pp. 245-247). This section is reprinted in the Federal grades for apple butter (cited in the next fn.).

<sup>2/</sup>United States Standards for Grades of Apple Butter, U. S. Department of Agriculture, Agricultural Marketing Service, effective August 5, 1957, 4 pp.

<sup>3/</sup>The bushel figure is included in the utilization for canning and freezing reported in Chapter II (Section A/1, pp. 3-5), but the pack figure is not included in the canned pack estimates (Section B/1, pp. 7-10).

<sup>4/</sup>For details see: J. A. Kitson and F. E. Atkinson, "Canned Baked Apples," Food Research Notes, Canada Department of Agriculture, Food Research Information Office (Ottawa), November 1964, p. 3.



As with butter there are no pack figures; but the processor noted above indicated that perhaps 150,000 bushels are used for baked apples, and that possibly 200 to 250,000 cases are packed.<sup>5/</sup> The market for these items appears to be relatively static.

#### C. Spiced Crabapples<sup>6/</sup>

In recent years there has been a relatively small pack of spiced whole crabapples put up in glass. The apples are neither cored nor peeled. Color is added. The product appears to largely be packed in Michigan. Several brands are available. Very limited quantities of pickled crabapples are also packed.

#### D. Concentrated Puree

A new concentrated apple product is being produced in Oregon for export to Latin America.<sup>7/</sup> Whole apples are chopped, then cooked, and run through a pulper and finisher. The material is concentrated under vacuum to about 28% solids and canned. The product is reconstituted for serving by addition of water and is reportedly used primarily as a beverage.

### VI. ADVERTISING AND PROMOTION

Apple sauce and slices are the object of modest advertising and promotion campaigns. These programs are carried on by national and State groups, and by individual processors. In most cases, emphasis is placed on canned products.

#### A. National Groups

The principal national organization promoting apple products is the Processed Apples Institute.<sup>1/</sup> The Institute was established by apple canners and has as its purpose "the promotion of the use and consumption of processed apples and apple products." There are presently fourteen active members, as well as a number of associate and contributing members.<sup>2/</sup>

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<sup>5/</sup>This figure is included with the estimates of the slice pack presented in Chapter II (Section B/1, pp. 7-10).

<sup>6/</sup>Spiced apple rings were discussed in Chapter IV (Section D, p. 50).

<sup>7/</sup>Information provided by Clyde Rasmussen, Product and Process Evaluation Staff, Agricultural Research Service, U. S. Department of Agriculture, Albany, California.

<sup>1/</sup>This section is based on a booklet, Processed Apples, Inc. -- An Association with a Working Program Serving the Apple Industry, November 1964, and a letter from Mabel Flanley, Executive Director of the Institute, November 18, 1964.

<sup>2/</sup>Most of these latter members are commercial firms. An exception is the Virginia Apple Commission (whose arrangements with PAI will be noted in the next section).

The Institute's program is conducted by a New York public relations firm. Emphasis is placed on the development, introduction, and promotion of new uses for canned apple products. This is done through the preparation and distribution of recipes, photographs, booklets and leaflets, and a film ("Every Day Is Apple Day"). These materials are aimed at the press, educators, and institutional operators.

The program is financed by (1) dues on members according to their output, and (2) contributions from the associate and contributing members. During the 1963 season \$155,600 was spent on sauce and slices.

In addition, the National Apple Institute -- a grower organization -- supports a public relations program which includes processed apples. Specifically, the NAI sponsors an "Apple Kitchen" which develops recipes, photographs, and educational materials on fresh and processed apples for distribution to the press, radio, and television.<sup>3/</sup>

#### B. State Groups

A group of apple canners in California recently established a Gravenstein Canners Promotion Committee. An initial budget of \$50,000 was established for promotion of the large 1964-65 pack in selected California markets. Although the program was financed by processors, the project was strongly supported by apple growers (and was directed by the manager of the grower organization).<sup>4/</sup>

In several States where advertising and promotion programs are financed by grower assessment, some funds are being spent by grower organizations. The most intensive effort is conducted by the Western New York Apple Growers Association. During the 1964 season this group spent about \$80,000 on sauce, slices (in baked form), and juice: \$56,000 of this went for a March-June advertising program using billboards and magazines, while much of the remainder was used for more general promotional activity. The group expects to increase its activities with processed products in the future and will give more attention to a year-round program.<sup>5/</sup> The program of the Michigan State Apple Commission concentrates on advertisements in magazines and trade papers, and on point of sale promotional material. About \$35,000 was spent on sauce and slices (pies) during the 1964 season.<sup>6/</sup> In Virginia the State Apple Commission has arranged with

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<sup>3/</sup>Based on discussions with Fred Corey, National Apple Institute.

<sup>4/</sup>"Gravenstein Apple Sauce Promotion," The Packer, December 5, 1964, p. 18; "Fruit-O-Scope," American Fruit Grower, January 1965, p. 39; letter from Fred Corey, National Apple Institute, February 19, 1965.

<sup>5/</sup>"Strong Spring Campaign by Western New York Apple Growers," The Packer, February 6, 1965, p. 11; interview with Ken Pollard, Western New York Apple Growers Association, February 2, 1965.

<sup>6/</sup>"Michigan State Apple Commission Approves \$373,500 Budget," Great Lakes Fruit Growers News, July 1964, p. 1; interview with Robert Button, Michigan State Apple Commission, February 12, 1965.

the Processed Apples Institute to conduct a special apple sauce promotion program in markets important to Virginia growers; about \$7,500 was budgeted for this purpose during 1964.<sup>7/</sup>

### C. Individual Processors

Despite increasing activity by National and State groups, the bulk of the advertising and promotion of processed apples is conducted by individual apple processors. The total amount involved, according to the Board of the Processed Apples Institute, is at least \$2 million.<sup>8/</sup> Major emphasis is placed on media advertising. Of the amount spent on media advertising by five processors in 1963, by far the largest portion was expended on television, followed at some distance by magazine and newspaper advertising.<sup>9/</sup>

In total, it appears that at least \$2.3 million is being spent annually to advertise and promote sauce and slices. There is presently interest in a cooperative effort among all the foregoing groups for more of a general effort on behalf of both fresh and processed apples at the national level.<sup>10/</sup>

## VII. FOREIGN MARKETS

There is currently a great deal of interest in expanding foreign markets for American products. What are the possibilities for apple sauce and slices? To shed some light on this matter, we first will analyze the present situation, and then evaluate the market potential.<sup>1/</sup>

### A. Present Situation

To start with, we will first consider world production and then look at United States exports.

#### 1. World Production

Only limited data appear to be available on world production of sauce and slices. However, what information we have suggests that the United States

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<sup>7/</sup>Processed Apples . . ., op. cit., pp. 15-16; interview with John Watson, Virginia State Apple Commission, February 12, 1965. Details are provided in Virginia Fruit, February 1965, pp. 34-36.

<sup>8/</sup>Flanley, op. cit.

<sup>9/</sup>"Brand-by-Brand List of 1963 Food Ad Expenditures," Food Field Reporter, November 9, 1964, p. 31.

<sup>10/</sup>See Ben W. Drew, "Proposed National Program for Advertising Apples," American Fruit Grower, February 1965, pp. 28, 30, 32.

<sup>1/</sup>Gilbert Sindelar and Robert FitzSimmonds of the Foreign Agricultural Service were of assistance in the preparation of this chapter.



is by far the leading producer of apple sauce and slices. This is true of both canned and dried forms.

a. Canned. Next to the United States, the leading producers for which we have pack data are Germany, Canada, the United Kingdom, Japan, and Australia. Data on production over a recent five-year period are summarized in Table 14.

Table 14. Average Production of Canned Apples, 1958-1962

<u>Nation</u>	<u>Production</u>
United States	303,400* tons
Germany	31,100#
Canada	12,700**
United Kingdom	9,300
Japan	9,200
Australia	6,700

\*Of this figure, sauce represented 233.6 thousand tons.

\*\*Of this figure, sauce represented 5.9 thousand tons.

# 1961-1962 average.

Source: Fruit, Commonwealth Economic Committee, London, 1964, pp.119, 121. The German figure was provided by the Fruit and Vegetable Division of the Foreign Agricultural Service.

Canada, it will be noted, was third in importance. Production and marketing practices are in general similar to those in the United States. Canadian production is largely concentrated in Nova Scotia, Ontario, and British Columbia. About 60% of the sauce is put up in Ontario, while Nova Scotia is the largest packer of sliced apples. In terms of per capita consumption, Canada is apparently well behind the United States.<sup>2/</sup>

In addition to the countries listed, apples are also canned in a number of European nations. During the 1959-62 period nearly 13% of the Dutch apple crop was made into sauce and slices.<sup>3/</sup> The comparable figure for

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<sup>2/</sup>Based on letters from: Ian F. Greenwood, Sun-Rype Products, Ltd., Kelowna, British Columbia, November 10, 1964; E. Zubeckis, Horticultural Experiment Station, Vineland Station, Ontario, November 12, 1964; and A. E. Calkin, Scotian Gold Cooperative, Ltd., Kentville, Nova Scotia, November 17, 1964.

<sup>3/</sup>Calculated from data provided by H. L. Norton, Assistant Agricultural Attache, American Embassy, The Hague, November 17, 1964.

Switzerland is probably less than 5% and is likely even lower in Italy, France, and Spain.<sup>4/</sup> The average in Japan for 1960-62 was 2.6%.<sup>5/</sup>

The division between sauce and slices varies between countries. In the Netherlands, the ratio of sauce to slice appears to have been about nine to one for the four-year period from 1959 to 1962.<sup>6/</sup> In Switzerland most of the pack is sauce; no slices are canned and only a few dried.<sup>7/</sup> A product which might be classified as a sauce is apparently put up in the Soviet Union.<sup>8/</sup> On the other hand, it would appear that most of the English pack is of slices and solid pack fruit; only one manufacturer puts up sauce.<sup>9/</sup> No sauce seems to be packed in Japan.<sup>10/</sup> Both sauce and slices are put up in Germany.<sup>11/</sup>

Samples of canned sauce were obtained from Switzerland, Holland, and Germany.<sup>12/</sup> The product was labeled as follows: German, "Apfelmus gezuckert"; French, "Puree de pommes sucee"; and Italian "Stacciato (or passata) di mele zuccherato." Although the weight was not marked, most of the cans contained about 850 grams (or approximately 30 oz.). Their price averaged 27.5¢/can in Switzerland and about 30¢/can in Germany. Tasting of the product revealed that the sauces were noticeably different from their American counterparts. The most obvious variation was in consistency. The German and Swiss sauces were mostly quite salvy and not unlike a puree (which some, in fact, were labeled). Moreover, the sauces were generally more tart than is usual in the United States -- though there did appear to be a wide range in sugar acid ratios. Flavor, aside from the tartness, was not as much different as might have been expected.

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<sup>4/</sup>Letter from Hans Luthi, International Federation of Fruit Juice Producers, Wadenswil, Switzerland, November 20, 1964.

<sup>5/</sup>Robert S. FitzSimmonds, Factors Affecting U. S. Fruit Markets in Japan, U. S. Department of Agriculture, Foreign Agricultural Service, FAS-M 161, August 1964, p. 11.

<sup>6/</sup>Norton, op. cit. It has been reported that the fastest-selling Heinz baby food in Holland is a blend of apple sauce with strained brown beans (The Wall Street Journal, November 9, 1964, p. 1).

<sup>7/</sup>Luthi, op. cit.

<sup>8/</sup>Letter from David M. Schoonover, Assistant Agricultural Attache, American Embassy, Moscow, December 21, 1964.

<sup>9/</sup>Letters from: Turner L. Oyloe, Assistant Agricultural Attache, American Embassy, London, November 20, 1964; and A. Pollard, Research Station, Long Ashton, Bristol, November 19, 1964.

<sup>10/</sup>FitzSimmonds, cp. cit.

<sup>11/</sup>Letter from Alexander Bernitz, Assistant Agricultural Attache, American Embassy, Bad Godesberg, January 5, 1965.

<sup>12/</sup>The samples were kindly provided by Messrs. Luthi and Bernitz.

b. Dried. Aside from the United States, leading producers of dried apples are Italy, Australia, Canada, South Africa, and New Zealand. Data on average production in these countries during the 1958-1962 period are presented in Table 15.

Table 15. Average Production of Dried Apples, 1958-1962

<u>Nation</u>	<u>Average Production</u>
United States	10,300 tons
Canada	260
Italy	880
South Africa	100
Australia	280
New Zealand	60

Source: Fruit, p. 173.

Minor quantities are also produced in several other nations, including the Netherlands and Switzerland.

## 2. U. S. Exports

a. Canned. Exports of canned apples are not normally very large. Data on exports for the six-year period from 1958 to 1963 are presented in Table 16. Unfortunately the data do not indicate what proportion was sauce or slices, but it is presumed that they were the principal item.

Table 16. U. S. Exports of Canned Apples  
1958 to 1963 Seasons

<u>Season</u>	<u>Cases (6/10)</u>
1958-59	40,700
1959-60	30,500
1960-61	30,000
1961-62	141,800*
1962-63	143,900*
1963-64	50,123

\*The big increase in exports during the 1961 and 1962 seasons was due to sharply increased imports by England which had a very poor crop of processing apples. England normally is a minor importer.

Source: Information Pertaining to World Production and Trade in Canned Fruit, U. S. Department of Agriculture, Foreign Agricultural Service, Fruit and Vegetable Branch, October 1962, p. 6. Also unpublished data provided by the Fruit and Vegetable Branch.



Over the six-year period exports accounted for slightly over 0.4% of the total pack of sauce and slices. If it is assumed that most exports were slices, then they represented up to 1.9% of the total slice pack. But as the period includes two unusually high years, it might be considered an atypical one. During 1963, which may be more representative, exports took about 0.3% of total production or up to 1.2% of the slice pack.

The biggest foreign market for canned apples is Canada. During the 1963 season, it took about 45% of United States exports. The rest of the exports were divided among a number of nations, including (in decreasing order of importance) Netherlands Antilles, Philippines, Venezuela, Mexico, Liberia, Panama, United Kingdom, Libya, and others. Exports to continental Europe amounted to about only 4.9% of the total and included only the following countries, in decreasing order: Netherlands, Denmark, Spain, Finland, and Italy.

b. Dried. A relatively large proportion of United States dried apple production is exported. Over the five-year period from 1958 to 1963, exports represented nearly 22% of production, ranging from a low of 13% to a high of 28%. Data on exports for individual seasons are provided in Table 17.

Table 17. U. S. Exports of Dried Apples  
1958 to 1963 Seasons

<u>Season</u>	<u>Exports</u>
1958-59	2,552 tons
1959-60	3,243
1960-61	1,147
1961-62	3,035
1962-63	2,679
1963-64	1,864

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Source: Dried Fruit, World Production and Trade Statistics,  
U. S. Department of Agriculture, Foreign Agricultural  
Service, Fruit and Vegetable Branch, April 1964, p. 6.  
Also unpublished data provided by the Fruit and Vegetable Branch.

During the 1963 season, the United Kingdom purchased about 24% of the dried exports, followed by Germany (21%), Venezuela (14%), Netherlands (9%), Canada (8%), Sweden (5%), and Finland (5%). Other importers included in decreasing order: Israel, Norway, Denmark, Mexico, Belgium and Switzerland. In previous seasons, German and Dutch imports were considerably higher.

#### B. Market Potential<sup>13/</sup>

In view of the limited foreign production of apple sauce and slices, and the modest foreign trade, it might at first appear that there is some

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<sup>13/</sup>This discussion is based on the references cited in the previous section.

potential for increasing United States exports of these items. There are, however, a number of dimensions to the foreign market which suggest caution in making any such appraisal.

The nature of consumer demand is of basic importance. It should be recognized that in many countries there is considerably more home canning or home preparation than in the United States. In Europe this is facilitated by the general availability (due in some cases to home production) of cooking varieties. These apples may be used for home canning in the fall or for preparation of fresh sauce and slices during the year (the English Bramley, for instance, has good keeping qualities and is available year-round). On the other hand, in some countries apples are not so nearly available and processed packs may be the only alternative.

It would be most helpful to have considerably more information on just how processed apples are used in other nations. It appears, for example, that canned sauce is mainly used as a meat accompaniment in the United Kingdom (consequently, the English also seem to prefer an unsweetened product). The importance and use of sauce in other nations is not very well known. As compared with United States usage, dried apples may well be more important overseas. They are seen fairly often in retail stores and are used at the institutional level (in the Netherlands, for example, they are used for remanufacture in tutti-frutti, cakes, tarts, pastries, etc., and in mixed fruit packages). It would also be of value to know what foreign consumers think of the apple products that are already available (perhaps some Europeans, for instance, do not consume more sauce because they consider their own packs to be of low quality).

Foreign markets are, furthermore, undergoing some changes which suggest problems and difficulties in the future. On the positive side, we find increasing levels of living in the more advanced nations which may well lead to a diminution of home canning and preparation. And many of the leading apple countries are swinging over to the production of fresh market varieties which are less well suited for home canning. On the other hand, the tariff and non-tariff barriers which now exist against American processed fruit in many nations may well become more severe. This would be particularly true of member nations of the European Economic Community. Moreover, as apple production increases in many foreign nations (as it is now doing in Italy and France) and where efforts are being made to develop more local processing, there may be less of a place for American canned fruit.

In view of the foregoing factors, one should evaluate foreign markets with care. The following general course of action would seem to be appropriate in considering the possibilities of expanding foreign sales: First, an attempt should be made to study present consumption practices and preferences in the prospective nation.<sup>14/</sup> Concurrently, tariff and

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<sup>14/</sup>Market potential studies have recently been conducted in Europe for cling peaches and fruit cocktail (Foreign Agriculture, February 15, 1965, p. 7) and citrus (The Packer, February 20, 1965, p. 3).

non-tariff barriers should be evaluated. In addition, the production situation should be studied in the general market. Finally, if these steps were to suggest a clear road for exports, then the possibility of a development program might be investigated.<sup>15/</sup>

## VII. CONCLUDING REMARKS

In drawing this paper to a close we shall present some observations on factors which may be expected to influence the outlook for sauce and slices. The first general area has already been introduced; it concerns the use of fresh market varieties for processing. The second area concerns competitive relationships at retail.

### A. Varietal Considerations

At the present time it appears that processors and consumers have different attitudes towards varieties. Processors clearly prefer certain hard varieties over others. The reasons for this preference are not entirely clear, but they may include the probabilities that the hard varieties are (1) more apt to produce a product that scores well on U. S. grades and, more importantly, (2) easier and less expensive to process. Consumers, conversely, do not seem to be particularly concerned with the question of variety -- especially with respect to sauce. In view of the current increase in production of fresh market varieties and the increased demand for processed products, it appears desirable to consider means of facilitating processor use of fresh market varieties in sauce and slices in the future.

Sauce. What would encourage a processor to use a higher proportion of fresh market varieties in his sauce blends?<sup>1/</sup> This is difficult to say. But possibly he might be more interested if: (1) the resulting product were likely to receive a higher grade than it does at present,<sup>2/</sup> or (2) the product could be produced more inexpensively. As the available research suggests that consumers are not particular about variety, they might not look upon greater use of fresh market apples as a downgrading of the product.<sup>3/</sup>

Assume, for purposes of discussion, that it were desirable to allow the sauce made with a higher proportion of fresh market varieties to receive

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<sup>15/</sup>Of course in this case there is the possibility that after a United States firm has developed a market, a local firm might move in on it.

<sup>1/</sup>Reference here is to normally finished regular sauce. It will be recalled that chunky sauces and blends with other fruits are not covered under present grades.

<sup>2/</sup>On the other hand, some U. S. Department of Agriculture officials who are associated with the grading of sauce do not feel that the standards markedly affect processor decision making. Rather, they point out the grades tend to follow processor practice.

<sup>3/</sup>Many wholesale buyers, however, might not share this sentiment.



a better score than it can at present. How would this be done with the current grade factors? One way might be to give more weight to flavor and less to consistency and texture (at present, it will be recalled, they are weighed equally). Fresh market varieties appear to rate well on flavor, but are not as likely to produce a sauce with good texture or consistency. Another approach would be the use of chemical treatments to produce a sauce with greater consistency.

What about the possibility of reducing costs for processing fresh market varieties? One of the stumbling blocks is the present mechanical peeling process: fresh market varieties just do not stand up as well under it as processing varieties. One answer, therefore, might be to eliminate peeling.<sup>4/</sup> It is possible to prepare sauce without peeling, but the resulting product is apt to have a brownish or reddish color. While research suggests that consumers are not very fussy about color, such a tint is considered undesirable by industry because (1) the sauce is apt to discolor in cans, and (2) a similar color can also result from improper processing (cooling). Hence the present grade standards tend to downgrade such a pack. The discoloration can be avoided by packing in glass, but there appears to be no ready answer for the similarity to the improperly processed product.

Obviously, there are a number of unanswered questions associated with each approach. Furthermore, there are some background factors concerning grades which should be understood. The present standards, established in 1950, were based on a thorough national survey of processors and buyers. The resulting standards expressed, as nearly as possible, the selection and weighing of factors which were felt to be desired by these two groups. Since that time, a continuing evaluation by the U. S. Department of Agriculture agency which works with grades has not shown any change in processor-buyer attitudes. Thus there is no evidence of any desire for modification of present standards.

But conditions do change and it is not inconceivable that the emerging supply and demand situation for apples may lead to increased interest in the matter of increasing the proportion of fresh varieties used in sauce. It would appear, therefore, to be an area well worth further investigation.<sup>5/</sup>

Slices. The use of fresh varieties for slices is a somewhat different issue. The big problems appear to be (1) the cost of peeling and coring fresh varieties, and (2) the need to maintain slice firmness.

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<sup>4/</sup>According to a recent trade publication, one Wisconsin packer who has eliminated the peeling and coring process is able to produce sauce at "a decided advantage in the case price" (Richard D. McCormick, "'Old Fashion' Apple Saucing Process -- No Peeling, No Coring," Canner/Packer, March 1965 [Vol. 134, No. 3], p. 31).

<sup>5/</sup>As we have noted (p. 27, fn. 15), work is already underway in Pennsylvania and Virginia on quality aspects of greater use of Red Delicious. No one, however, appears to be studying the many implications of modification or elimination of the peeling process.

Slices have to be cored and peeled -- and more carefully than for sauce. Processors feel that this step is more easily and inexpensively done with processing varieties. Yet there is little research available that would quantify this point.<sup>6/</sup> Further study of costs under existing and/or new technologies (such as infrared peeling) would appear to be desirable as a guide to pricing policies. Processors also feel -- with some justification -- that fresh varieties produce soft slices. In this case, however, a considerable amount of work has been done on chemical firming treatments. Whether they are being widely used or not, however, may be another matter.

#### B. Competitive Relationships

The demand for sauce and slices is, of course, influenced by the availability of competing products. Sauce, as we have noted, is sold at retail as packed while slices are largely reprocessed.

Sauce. Competing products for processed sauce vary according to usage. Sauce that is used as a meat accompaniment (say as a side dish for pork) or as a cake ingredient, does not face many competing items.<sup>7/</sup> But sauce that is used for a dessert competes with many other fruits. Unfortunately, we do not have data which indicate the quantity of sauce used in each of these categories, but it does not seem unlikely that dessert uses represent the biggest proportion. As the newer sauce products -- chunky and the fruit blends -- appear to be aimed at the dessert sphere, they are facing at once the larger and more competitive market. Moreover, chunky sauce that is promoted for cooking in pies is competing with other pie ingredients, including apple slices.

Slices. In one way or another, nearly all institutional or retail packs of slices end up being consumed in some sort of baked form. Pie is undoubtedly the most important followed by cakes, puddings, etc. Whether the consumer purchases her apples already baked or as canned slices or pie filling, there is a wide variety of competing items available: there are many fruit pies and fruit pie fillings on the market, not to mention the many non-fruit ingredients. Still, apple remains the leading fruit pie ingredient.<sup>8/</sup>

The advertising and promotion for these two items so far has emphasized dessert use -- as a regular sauce and in the form of pies. The promotional work has also mentioned use as a meat accompaniment, and to a limited extent as a cake ingredient. In view of the limited resources available, the balance has probably been a reasonable one.

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<sup>6/</sup>The Virginia studies referred to in the text did not include fresh varieties such as Red Delicious or McIntosh.

<sup>7/</sup>The few competitors as a meat accompaniment probably include spiced apple rings and crabapples.

<sup>8/</sup>See Ben C. French, "Some Economic Aspects of Pie Consumption," Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, February 1959, p. 493.

One market possibility, however, may be relatively unexplored and unpromoted. This is the potential for a spiced sauce. As we noted earlier, a New York study revealed that about half of the homemakers added spice -- principally cinnamon -- to their sauce. At present about the only commercially prepared sauce that is available with spice is one of the new chunky sauces. It is not clear why processors have not taken more of an interest in such a product (they have produced spiced apple rings and crabapples for some time). One advantage of a spiced sauce would be that its demand would be more highly differentiated than for regular sauce: it would not directly compete with as many items. But for such a product to gain acceptance, a more intensive advertising campaign may well be necessary.

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All told, the prospects for apple sauce and slices would seem to be relatively good -- provided that the industry continues to work on the improvement of production and marketing practices.

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